University of Alberta

Clarifying the Relationship Between Autonomy Support, Motivation, Performance and Related Educational Outcomes: A Meta-Analysis

by

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Abstract

A meta-analysis of 38 research reports examined the relationship between perceived autonomy support and motivation, performance, and related educational outcomes across varying levels of education. Results indicate that perceived teacher autonomy support significantly and positively relates to academic performance, cognitive engagement, introjected regulation, identified regulation, intrinsic motivation, self-determination, and perceived academic confidence. Perceived teacher autonomy support was found to significantly and negatively relate to external regulation. Similar results were found for the relationship between perceived parental autonomy support and the same variables, with the exception of introjected regulation, which did not relate. Moderator analysis revealed that the strength of the relationship between perceived teacher autonomy support and motivation outcomes varies as a function of the educational level of students.

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Dedication

I would like to dedicate this work to my wife, Shelagh Dunn. Her sense of passion and commitment to her beliefs are examples to which I continue to aspire. Her unwavering support and continued belief in me are the main reasons I've been able to achieve all of my accomplishments. It is because of her that I've been able to follow my dreams.

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LIST OF SYMBOLS

e - 2.71828183

v_θ - estimate of the random effects variance

ES_{Zr} - transformed effect size statistic

$\overline{ES}_{Zr}$ - transformed weighted mean effect size

i - index of studies

j - index of moderation subgroups

k - number of effect sizes in each moderation subgroup

l - index of meta-analysis groups

m - number of effect sizes in each meta-analysis subgroup

n - sample size

$\overline{N}$ - mean sample size with the sample size for effect size *i* removed

$\overline{r}$ - average correlation coefficient

r - reported bivariate correlation coefficient

Q - chi-square statistic

Q_w - within groups chi-square statistic

Q_b - between groups chi-square statistic

$SAMD$ - sample adjusted meta-analytic deviancy statistic

$SE_{\overline{ES}_{Zr}}$ - standard error of the transformed weighted mean effect size

SE_{Zr} - standard error of the transformed effect size

$Var(ES_i)$ - sampling error variance of the sampling distribution of effect size *i*

$Var(\overline{ES}_{Zr\ w/o\ study\ i})$ - sampling error variance for the mean transformed effect size with sample *i* removed

w_{Zr} - inverse variance weight of the transformed effect size

CHAPTER I - BACKGROUND

Introduction

The belief that experiencing a sense of control is an important part of how we define ourselves as individuals has begun to permeate education systems around the world. Students are no longer viewed as empty vessels for whom teachers are responsible to fill, but instead are being considered as autonomous individuals whose need to experience a sense of control over their learning should be supported rather than taken away. For example, consider the situation where students sit in a dimly lit classroom while their teacher monotonously writes out notes on an overhead about the French Revolution. At the end of the class, the teacher informs the students that they will be tested on these notes next week. Alternatively, consider a group of students who have been given a choice of three topics for which they are to write an informative essay. Students are told that once they have selected a topic to write on, they can go to the library to choose any related book to serve as the subject of their essay. One student decides to write about the French Revolution and chooses to read Victor Hugo's *Les Miserables*. Of the students described in the two examples, who is going to be more motivated to learn about the French revolution? And are there going to be differences in the quality of learning that the students experience? More and more evidence is accumulating to suggest that because the autonomy of the student from the second situation was supported, he or she will be more motivated to learn and as a result will have a higher quality learning experience than one of the students described in the first situation.

As the belief that we should support student autonomy is becoming more widely accepted, research on the effects of autonomy support has increased. In this thesis, I examine the relationship between autonomy support and educational outcomes like academic performance, motivation, and engagement. First, I examine the overall nature and strength of

the relationship between both parental and teacher autonomy support and educational outcomes and second, I examine whether the strength of the relationship between autonomy support and educational outcomes varies based on the level of education for which the autonomy support is being provided.

Literature Review

The idea that feeling autonomous relates to motivation and learning was first introduced by deCharms (1968) and further developed by Deci and Ryan (1985). According to Deci and Ryan (1987), autonomy support involves encouraging individuals to make their own choices so that behaviour becomes "endorsed by the whole self and is experienced as action for which one is responsible" (p. 1025). In other words, autonomy support involves providing opportunities for choice that enhance an individual's sense of self-determination (or autonomy). Deci and Ryan (1985) proposed a theory of self-determination to describe how autonomy supportive and controlling contexts impact motivation as well as other aspects of human behaviour. According to self-determination theory, people are naturally intrinsically motivated to interact with the environment in ways that promote learning and mastery (Ryan & Deci, 2000 as cited in Patall, Cooper, & Robinson, 2008) but because people are social cognitive beings who are affected by contextual variables, our intrinsic motivation to learn can be affected by how we perceive the environment. Specifically, self-determination theory predicts that environments that are experienced as controlling are expected to decrease self-determination and intrinsic motivation to learn, where as environments that are perceived to be autonomy-supportive are expected to increase self-determination and intrinsic motivation to learn (Deci, Schwartz, Sheinman, & Ryan, 1981). When applied to education, self-determination theory suggests that autonomy support should relate positively to intrinsic motivation to learn, self-determination, academic performance, cognitive engagement, and perceptions of competence (Deci, Vallerand,

Pelletier, and Ryan, 1991; Reeve, 2002). Investigations of the claims put forth by self-determination theory within the context of education are reviewed next.

The Effect of Autonomy Support on Educational Outcomes

The relationship between autonomy support and educational outcomes has been studied using two types of research designs. First, in an attempt to determine the causal implications of autonomy support, researchers have employed experimental designs that test if autonomy supportive interventions lead to significant differences on various educational variables such as intrinsic motivation and academic performance. More often, however, researchers have employed correlational designs to test the relationship between student perceptions of autonomy support and various educational outcomes. For both types of studies, the effects of autonomy support on the following educational outcomes are reviewed: academic performance, cognitive engagement, external regulation, introjected regulation, identified regulation, intrinsic motivation, self-determination and perceived competence. Prior to summarizing investigations of the relationship between autonomy support and each of the educational outcomes, definitions of the educational outcomes are provided.

Academic Performance

Definition. For the purpose of this study, academic performance is defined as the observable manifestation of knowledge, skills, concepts, and understanding of ideas (Tuckman, 1975). According to this definition, scores on standardized achievement tests, domain specific examinations, course grades, and overall GPA are all considered valid indicators of academic performance.

Experimental studies that have investigated the effect of autonomy support on academic performance generally support the hypothesis that autonomy support increases academic performance. For example, in a study that investigated the effect of autonomy

support interventions on math learning, Cordova and Lepper (1996) found that elementary students who were provided opportunities for choice concerning incidental aspects of the learning context scored higher on math tests than students who were not provided opportunities for choice, $t(65) = 2.02$, $p < .05$. Similarly, Cordova and Lepper (1996) found that students whose personal interests were acknowledged within math tasks scored higher on math tests than students whose personal interests were not acknowledged, $t(65) = 4.89$, $p < .0001$. In a more recent experimental investigation, Vansteenkiste, Simons, Lens, Sheldon, and Deci (2004) found that, in three separate studies (two conducted with post-secondary students and one conducted with high school students), students taught using autonomy supportive instructions scored higher on domain specific tests than students taught using controlling instructions in three different educational domains (Science, Marketing, and Physical Education) $F(1, 196) = 83.22$, $p < .001$; $F(1, 373) = 168.94$, $p < .001$; $F(1, 202) = 57.81$, $p < .001$. Although these findings provide evidence to support the causal effect of autonomy support on academic performance, they also demonstrate that there is variation in the strength of the effect. That is, the effects reported for elementary students by Lepper and Cordova (1996) were smaller than the effects reported for students in higher grade levels by Vansteenkiste et al. (2004). Further, for the effects reported by Vansteenkiste et al. it appears that there may be differences in the strength of the effect across different educational domains.

Correlational studies that have investigated the relationship between parental autonomy support and academic performance have produced results that are somewhat mixed. For example, in a longitudinal study of the relationship between maternal autonomy support and education outcomes, Joussemet et al. (2005) reported a non-significant correlation between self-report ratings of perceived maternal autonomy support and elementary students' math achievement, $r = -0.06$. Alternatively, Grolnick and Ryan (1989) investigated the relationship

between objective autonomy support ratings of parent interviews and elementary students' school grades and found a correlation of $r = 0.46$, indicating that more autonomy supportive parental interview ratings were associated with higher student grades. A similar amount of variation has been reported for the relationship between teacher autonomy support and student academic performance. For example, in a study of the relationship between self-reported perceived teacher autonomy support and high school students' GPA, Soenens and Vansteenkiste (2005) report a non-significant correlation of $r = 0.02$. Alternatively, in a study of the relationship between self-report ratings of perceived teacher autonomy support and the test scores of organic chemistry students, Black and Deci (2000) report a correlation of $r = 0.29$. These mixed results indicate variation in the reported strength of the relationship between autonomy support and academic performance.

Cognitive Engagement

Definition. According to Richardson and Newby (2006), cognitive engagement is defined as "the integration and utilization of students' motivations and strategies in the course of their learning" (p. 23). Cognitive engagement has been operationalized using behavioral indicators of heightened concentration or engagement as well as indicators of the use of more complex as opposed to more rudimentary problem solving strategies.

Experimental studies of the effect of autonomy support on cognitive engagement have supported the hypothesis that autonomy support leads to increased cognitive engagement. Guthrie, Wigfield, and VonSecker (2000) compared the strategy use of 5th grade students taught using an autonomy supportive, concept oriented reading approach to the strategy use of students taught using traditional methods and found that students in the autonomy supportive condition used significantly more complex strategies than the students in the traditional instruction condition, $F(1, 86) = 4.65$, $p < .05$. Similarly, Cordova and Lepper (1996) found that

students in autonomy supportive conditions used more strategic moves during a math task than students in non-autonomy supportive conditions, $t(65) = 7.23$, $p < .0001$. According to these results, it appears that autonomy support leads to significant increases in cognitive engagement.

Correlational studies that have investigated the relationship between autonomy support and cognitive engagement have produced somewhat more consistent correlations than were found for academic performance. For example, Dai (1998) reports correlations of $r = 0.25$ and $r = 0.19$ for the relationship between self-reported measures of perceptions of parental autonomy support and self-reported learning strategy use for North American and Chinese junior/senior high school students, respectively. Similarly, for the relationship between self-report perceived parental autonomy support and self-reported levels of concentration of Chinese post secondary second language students, Vansteenkiste et al. (2005) report a correlation of $r = 0.28$. Based on these results, it appears that parental autonomy support relates positively to cognitive engagement similarly across different cultures.

For the relationship between teacher autonomy support and cognitive engagement, correlations appear to be stronger. For example, Skinner and Belmont (1993) report a correlation of $r = 0.59$ for the relationship between self-report ratings of perceived teacher autonomy support and elementary students' self-report ratings of engagement. Further, for the relationship between junior high school students' self -report ratings of perceived teacher autonomy support and their self-report ratings of academic involvement, Stiller and Ryan (1992) report a correlation of $r = 0.41$. The observed results for the relationship between teacher autonomy support and cognitive engagement suggest that teacher autonomy support is more strongly associated with cognitive engagement than parental autonomy support.

Self-Regulation Variables

Definitions. Self-regulation variables include external regulation, introjected regulation, identified regulation, intrinsic motivation, and self-determination. According to self-determination theory (Ryan & Deci, 2000), external regulation, introjected regulation, identified regulation, and intrinsic motivation represent categories on a continuum of motivated behaviour. Starting from the former and moving toward the latter, external regulation represents the most non-self-determined form of motivated behaviour. It is characterized by being motivated because of external rewards or punishments and is considered the most controlled form of motivation. Following external regulation is introjected regulation, which is characterized by behavior that is a result of following rules not for reasons of personal value or belief but simply because the rules are in place. Introjected regulation is also not a self-determined form of motivation. Next is identified regulation, which occurs when individuals value behavior because it helps to fulfill an externally valued belief that has been internalized. For example, students might study hard because they have internalized their parents belief that doing well in school is something that is important to them. Identified regulation is characterized by experiencing a sense of choice when acting and is considered to be more self-determined. Next is intrinsic motivation, which is characterized by choosing to behave based on enjoyment and inherent interest (Ryan & Deci, 2000b). Intrinsic motivation represents the most self-determined form of motivation. The fifth self-regulation variable, self-determination, is simply the degree to which students regulate their behaviour based on self-determined forms of motivation as opposed to non-self-determined forms of motivation. For example, in a school setting students may experience external regulation one moment, intrinsic motivation the next, or a combination of the different forms of regulation at any given time. The self-determination variable identifies whether students are generally more externally motivated versus intrinsically

motivated. It does not actually represent a new variable but is calculated using a weighted composite of the four regulation variables to provide a global indication of self-determination.

With the exception of intrinsic motivation, which has been operationalized differently by many researchers, self-determination variables within the context of education are almost exclusively measured using the Self-Regulation Questionnaire (SRQ, Ryan & Connell, 1989) and domain specific versions of the SRQ. The SRQ is made up of four subscales of self-report items, one for each of the first four self-regulation variables (i.e., external regulation, introjected regulation, identified regulation, and intrinsic motivation). A higher score on any subscale indicates a higher level of endorsement of that regulatory style. Once the scores for each subscale have been calculated, a self-determination index (some times referred to as a relative autonomy index) is calculated using the formula: 2 X Intrinsic + Identified - Introjected - 2 X External.

According to these definitions, Ryan and Deci (2000) hypothesize that autonomy support should increase identified regulation, intrinsic motivation, and overall self-determination. Also, autonomy support is expected to decrease external regulation and introjected regulation. In order to verify these claims, studies that have investigated the relationship between autonomy support and each self-regulation variable are reviewed.

External regulation. Only one experimental investigation has explicitly investigated the effect of autonomy support on external regulation. Prusak et al. (2004) found that junior high school physical education students who were offered choices in the types of activities they would complete were significantly less externally regulated than students that had not been offered choices $F(1,40) = 8.62$, $p < .01$. The result appears to support the hypothesis that autonomy support leads to decreased external regulation.

Many more correlational studies have investigated the relationship between autonomy support and external regulation. Results appear to be quite consistent for studies that have related self-report measures of perceived parental autonomy support to self-reported external regulation. For example, Chirkov and Ryan (2001) report correlations of $r = -0.21$ and $r = -0.26$ for samples of senior high school students from North America and Russia, respectively, while Watts (2004) reports a correlation of $r = -0.19$ for a sample of North American junior high school students. For the relationship between self-reported measures of perceived teacher autonomy support and external regulation, the results appear to be more mixed. For example, Ntoumanis (2005) reports a correlation of $r = -0.28$ for a sample of British senior high school students, while Williams and Deci (1996) report a correlation of $r = -0.06$ for a sample of North American medical students.

Introjected regulation. No experimental studies were found that investigated the effect of autonomy support on introjected regulation. However, many correlational studies have investigated the relationship between autonomy support and introjected regulation. Results for the relationship between perceived parental autonomy support and introjected regulation are mixed. Dai (1998) reports correlations of $r = -0.25$ and $r = -0.31$ for North American and Chinese senior high school student samples, respectively, where as, Vierling, Standage, and Treasure (2007) report a correlation of $r = 0.12$ from a sample of British senior high school students. For the relationship between perceived teacher autonomy support and introjected regulation, results are equally mixed. Chirkov and Ryan (2001) report correlations of $r = 0.03$ and 0.08 for samples of North American and Russian high school students, respectively, while Standage, Duda, and Ntoumanis (2006) report a correlation of $r = -0.22$ for a group of British junior high school students. As was the case with external regulation, these results suggest variation in the reported correlation between perceived teacher autonomy support and introjected regulation.

Identified regulation. Again, only one experimental investigation explicitly investigated the effect of autonomy support on identified regulation. Prusak et al. (2004) found that junior high physical education students who were offered choices of activities reported significantly higher identified forms of regulation than students who had not been offered opportunities for choice $F(1,40) = 7.91$, $p < .01$. The result appears to support the hypothesis that autonomy support leads to increased identified regulation.

Many more correlational studies have investigated the relationship between autonomy support and identified regulation. Results from these investigations appear to be quite consistent. First, for the relationship between self-report measures of perceived parental autonomy support and identified regulation, the reported correlations tend to be moderately positive. For example, Watts (2004) reports a correlation $r = 0.29$ for a North American sample of junior high school students, while Vierling et al. (2007) report a correlation of $r = 0.27$ for a sample of British senior high school students. For the relationship between perceived teacher autonomy support and identified regulation, a similar consistency is revealed. For example, Ryan and Connell (1989) report correlations of $r = 0.29$ and $r = 0.20$ for two samples of North American elementary students, while, in two separate studies, both Hardre and Reeve (2003) and Hagger et al. (2003) report a correlation of $r = 0.38$ for North American junior-senior high school students. The results appear to support a moderately positive relationship between autonomy support and identified regulation, although the results seem to suggest that the strength of the relationship may vary depending on the educational level of the students. That is, the correlations for the elementary students appear to be weaker than the correlations for the junior-senior high school students.

Intrinsic motivation. Multiple experimental studies of the effect of autonomy support on intrinsic motivation provide substantial evidence to support a causal relationship. First, Deci

et al. (1994), found that post secondary students randomly assigned to an autonomy supportive condition were more intrinsically motivated than students randomly assigned to a non-autonomy supportive condition, $F(1,184) = 11.9$, $p < .01$. Also, in three separate studies conducted in three different domains with two post secondary and one senior high school group of students, Vansteenkiste et al. (2004) found that students in autonomy supportive conditions characterized by the provision of instructional choice were more intrinsically motivated than students in instructionally controlling conditions, $F(1, 196) = 50.40$, $p < .001$; $F(1, 373) = 169.96$, $p < .001$; $F(1, 202) = 81.68$, $p < .001$, respectively. These results reveal that autonomy support appears to causally affect intrinsic motivation. It should be noted however, that in the three studies conducted by Vansteenkiste et al. (2004), the strength of the effect does vary depending on the domain within which the study was conducted. That is, Vansteenkiste et al. (2004) conducted the studies in science, marketing, and physical education domains respectively. The strongest effect was observed in the marketing domain followed by physical education and science, respectively.

As was the case for identified regulation, correlational research of the relationship between autonomy support and intrinsic motivation appears to reveal consistent positive correlations. For example, Vansteenkiste et al. (2005) report a correlation of $r = 0.16$ for the relationship between self-report measures of perceived parental autonomy support and self-reported intrinsic motivation of post-secondary Chinese students. Similarly, Chirkov and Ryan (2001) report correlations of $r = 0.14$ and $r = 0.16$ for North American and Russian senior high school students, respectively. For the relationship between perceived teacher autonomy support and intrinsic motivation, results appear to be slightly stronger but also appear to be more varied. For example, Garcia and Pintrich (1996) report a correlation of $r = 0.58$ for North American post secondary students, yet Ryan and Grolnick (1986) report correlations of $r = 0.22$

and $r = 0.37$ for two samples of North American elementary school students. Once again there is evidence to suggest that the relationship between perceived teacher autonomy support and intrinsic motivation might vary across the educational level of the students (i.e., elementary vs. secondary students).

Self-determination. Experimental studies of the effect of autonomy support on self-determination support the hypothesis that autonomy support increases self-determination. For example, in three studies with two samples of post-secondary students and one sample of senior high school students, Vansteenkiste et al. (2004) demonstrated that students in autonomy supportive conditions characterized by offering instructional choice exhibited more self-determination than students in controlling instructional conditions, $F(1, 196) = 637.21$, $p < .001$; $F(1, 373) = 344.56$, $p < .001$; $F(1, 202) = 100.94$, $p < .001$, respectively. Similarly, Reeve et al. (2002) found that post-secondary students who were communicated rationales for uninteresting tasks in autonomy supportive ways exhibited higher self-determination than students who were communicated rationales in controlling ways, $t(33) = 2.69$, $p < .05$. These results suggest that autonomy support does leads to increased self-determination.

Correlational research on the relationship between autonomy support and self-determination is, once again, somewhat mixed. For example, for the relationship between self-report measures of perceived parental autonomy support and the self-determination index as calculated from the four subscales of the Self-Regulation Questionnaire (SRQ), Vallerand, Fortier and Gauy (1997) reported a relatively strong correlation, $r = 0.53$, for a sample of North American senior high school students, while Padmawidjaja (1998) reported a somewhat smaller correlation of $r = 0.11$ for a sample of North American elementary students. Similar variation was uncovered for the relationship between self-report measures of perceived teacher autonomy support and the self-determination index. Once again, Vallerand et al. (1997)

reported a moderately high correlation of $r = 0.47$ for a group of North American senior high school students, while Stiller and Ryan (1992) reported a somewhat lower correlation for North American elementary students, $r = 0.25$. Again, these results indicate variation that might be attributable to the level of education of the students.

Perceived Academic Competence

Definition. For the purpose of this study, perceived academic confidence is defined as an individual's expressed confidence in their ability to learn and understand academic material. Perceived academic competence can be operationalized with global measures that ask students to report their perceived competence for learning in general terms or with more domain specific measures that ask students about their perceived competence in specific subject areas like math or science.

Experimental studies of the effect of autonomy support on perceived academic competence support the claim that autonomy support leads to increased perceptions of academic competence. Sansone (1989) found that post-secondary students who were given a choice of puzzles had higher self-reported perceptions of task competence than students who were not offered a choice, $F(1, 115) = 4.67$, $p < .05$. Similarly, Cordova and Lepper (1996) found that elementary students in three different autonomy support conditions (creating a meaningful learning context, creating an individually appealing learning context, and providing choice for incidental aspects of the learning context), had higher perceptions of mathematic competence than students in a control condition, $F(1, 65) = 5.10$, $p < .05$; $F(1, 65) = 3.98$, $p < .05$; $F(1, 65) = 7.97$, $p < .05$, respectively. These results suggest that autonomy support may lead to increased perceptions of competence.

Correlational studies of the effect of autonomy support on perceived academic competence reveal mixed results. For the relationship between self-report ratings of perceived

parental autonomy support and self-report ratings of perceived academic competence, correlations tend to be moderately positive. For example, Dai (1998) reports a correlation of r = 0.20 for a sample of North American junior high school students and r = 0.22 for a sample of Chinese senior high school students. Lueng and Kwan (1998) report a similar strength correlation for a sample of Chinese junior high school students, r = 0.24. Alternatively, results from studies investigating the relationship between self report-ratings of perceived teacher autonomy support and self-report ratings of perceived academic competence tend to be somewhat mixed. For example, Soenens and Vansteenkiste (2005) report a correlation of r = 0.05 for Belgian senior high school students, where as Sheldon and Krieger (2007) report a correlation of r = 0.48 for post-secondary law students. Although the results for perceived parental autonomy support appear somewhat consistent, the results based on perceived teacher autonomy support appear to vary.

A Need for Synthesis

The primary reason for a need to synthesize the findings of the effect of autonomy support on educational outcomes is that results appear to be somewhat mixed. Specifically, three types of variations have emerged from the above literature review. First, it appears that for some of the educational outcomes, for example, introjected regulation, correlations with self-report ratings of perceived autonomy support vary from being statistically insignificant to statistically significant. Second, the observed correlations between self-report ratings of perceived autonomy support and some of the educational outcomes suggest that depending on who is providing the autonomy support, parents or teachers, the strength of the relationship might differ. Third, the literature review provides some evidence to suggest that depending on the educational level of the students, the relationship between self-report ratings of perceived autonomy support and certain educational outcomes might also differ. In order to investigate

whether the observed relationships from the preceding literature review are genuine, a systematic summary of all studies that have investigated the relationship between perceived autonomy support and educational outcomes is required. Given that there have been numerous studies that have investigated the relationship between self-report ratings of perceived autonomy support and the identified educational outcomes, the widely used technique of meta-analysis can be used to generate a more complete understanding of how perceived autonomy support relates to the selected educational outcomes. Prior to introducing the specific research questions that will be investigated, a brief introduction to what meta-analysis involves and the steps required to carry out a meta-analysis is provided.

Meta-Analysis

Meta-analysis is "a method of summarizing the empirical results of empirical studies within the behavioural, social, and health sciences" (Lipsey & Wilson, 2001, p. 1). In meta-analysis, research reports, rather than people, are surveyed to answer research questions about how the distributions of reported results vary as a function of codable study characteristics such as population characteristics or research design characteristics. Initially, meta-analysis was used to answer general questions about whether certain treatment techniques were indeed effective. For example, in order to address the controversy over whether psychotherapy techniques were in fact effective for treating patients, Smith and Glass (1977) standardized and averaged treatment-control differences for 375 psychotherapy studies and found that psychotherapy did indeed have statistically significant positive treatment effects (Lipsey & Wilson, 2001). More recently however, meta-analysis has been used to answer questions about how the strength of effects might vary depending on certain study characteristics. For example, in a meta-analysis of the effect of choice on intrinsic motivation, Patall, Cooper, and Robinson (2008) found that the reported effect sizes from studies where individuals were offered multiple successive choices

were larger than the reported effect sizes from studies where individuals were offered a single choice.

Three basic steps are required to conduct meta-analysis. First, the researcher gathers and defines the population of studies that is to be meta-analyzed. Second, identified research reports are coded based on pre-determined set of study characteristics. Third, meta-analytic statistical analysis is used to identify patterns of findings in the distribution of observed effect sizes. Each step involves numerous sub-steps that are described in more detail in the methods section. For now, the discussion turns to the specific research questions that will be investigated in the present meta-analysis.

Purpose and Associated Research Questions

The purpose of the present meta-analysis is to (a) clarify if the relationships between perceived parental autonomy support and the educational outcomes are indeed statistically significant, (b) determine if the relationships between perceived teacher autonomy support and the educational outcomes are statistically significant, and (c) determine whether the strength of significant relationships vary as a function of the educational level of the students for which the correlations were observed. In order to address these issues, the following three research questions have been developed:

1. *Does perceived parental autonomy support significantly relate to the selected education outcomes?*
2. *Does perceived teacher autonomy support significantly relate to the selected education outcomes?*
3. *Does the level of education of students in samples used to calculate effect sizes account for systematic differences in the strength of the relationships between perceived autonomy support and the educational outcomes?*

In order to answer the first two research questions, statistical techniques are applied to groups of effect sizes investigating the relationship between perceived parental autonomy and the educational outcomes and groups of effect sizes investigating the relationship between percieved teacher autonomy support and the educational outcomes, respectively, to produce average effect sizes[1] that can be tested for statistical significance. Two sets of analyses are required to answer the third research question. In the first set of analyses, the homogeneity of the distributions of the observed effect sizes used to calculate average effect sizes is tested because (a) although an average effect size statistic may be identified as statistically significant, if the distribution of observed effect size statistics used to calculate the average effect size is found to be heterogeneous, the resulting average effect size cannot be reliably interpreted, and (b) distributions of observed effect sizes identified as heterogeneous could be representing more than one underlying population distribution. That is, different study characteristics, known as moderator variables, might result in differences in the strength of observed effect size statistics. Therefore, in the second set of analyses used to answer question three, effect size distributions identified as heterogeneous are tested using moderation analysis to determine if the strength of observed effect sizes vary as a function of the predicted moderator variable.

Moderator analysis involves testing whether specific study characteristics function to produce systematic differences in sub-groupings of observed effect sizes. For example, Patall et al. (2008) used moderator analysis in their meta-analysis of the effect of choice and intrinsic motivation to show that the effect sizes associated with studies that provided multiple successive choices were stronger than the subgroup of effect sizes produced from studies that offered a single choice. In other words, "number of choices" was identified as a moderator

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[1] Combined effect sizes represent weighted averages that place more emphasis on studies with larger sample sizes.

variable because it was found to lead to statistically significant differences in the strength of the reported effect sizes in the studies included in the meta-analysis. In the present meta-analysis, moderation analysis is used to determine if the educational level of students leads to statistically significant differences in observed effect sizes. A more detailed description of the statistical techniques used to answer the research questions is provided in the methods section.

Hypotheses. Two hypotheses have been developed based on theory and the preceding literature review. First, according to how self-determination theorists view the impact of autonomy support on educational outcomes, the meta-analysis should uncover significant, homogeneous, and positive relationships between autonomy support and academic performance, identified regulation, intrinsic motivation, self-determination, and perceived competence, as well as significant, homogeneous, and negative relationships between autonomy support and external regulation and introjected regulation. Second, the educational level of students is expected to function as a moderator variable of the relationships between perceived teacher autonomy support and some of the educational outcomes because the preceding literature review regularly revealed variability depending on the educational level of students. Having established the purpose of the meta-analysis, the research questions that are being investigated, and predictions about what the meta-analysis might reveal, the discussion now turns to a detailed description of the steps implemented to conduct the meta-analysis.

CHAPTER II - METHODS

The method section is divided into three parts: identifying the population of studies, survey protocol, and statistical methods of data integration. Each section represents the basic steps required for conducting meta-analysis. Within each section a detailed description of the steps employed is provided.

Indentifying the Population of Studies

The techniques used to search the autonomy support literature along with the criteria used to determine which studies to include in the meta-analysis are described in the present section.

Literature Search Procedures

Two broad search strategies were used to find published and unpublished research reports of the relationship between autonomy-support and related educational outcomes. First, computer searches of ERIC, PsychINFO, and ProQuest Dissertations and Theses electronic databases using *autonomy support* as the key search term were conducted for studies catalogued prior to May 2008[2]. Second, the Web of Science electronic database was used to search Science Citation Index Expanded, Social Sciences Citation Index and the Arts and Humanities Citation Index for articles catalogued before May 2008, which cited Deci and Ryan's (1987) seminal article on autonomy support as a social cognitive phenomenon. After applying these search strategies, a total of 79 research reports were found on the relationship between autonomy support and related educational outcomes. Of the 79 reports, five were not written in English and three were not included because they contained insufficient information to

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[2] May 2008 was the latest possible date for which studies could be included in the meta-analysis to be analyzed in time for me to defend the thesis. Any studies that have been conducted after May 2008 can be included in future analyses.

calculate the appropriate effect size statistic[3]. Attempts were made to contact the authors of these three reports but results could not be provided. As a result, the total population of research reports was reduced to 71. Having identified all studies of the relationship between autonomy support and the educational outcomes of interest, the next step was to ensure that the studies were comparable for meta-analysis.

Criteria for Inclusion

Certain criteria had to be met for a research report to be included in a meta-analysis. According to Lipsey and Wilson (2001), the following types of criteria should be considered when identifying studies to be included in a meta-analysis: publication type, research design characteristics, sample characteristics, and key dependent and independent variables. For the purpose of the present meta-analysis, peer reviewed journal articles, dissertations, theses and conference papers were all deemed acceptable types of publications and were included in the meta-analysis. On the basis of this criterion, none of the 71 studies were excluded from the meta-analysis. Next, all reports included in the meta-analysis had to use a correlational design to investigate the relationship between autonomy support and related educational outcomes. This criterion was employed because only one type of design can be synthesized in a single meta-analysis. Correlational designs were the subject of this meta-analysis because, of the 17 research reports that used experimental designs to investigate the relationship between autonomy support and educational outcomes, very few reported results for similar types of comparison. For example, in some experimental studies, autonomy support groups were compared to groups that received no intervention, while in other studies, autonomy support groups were compared to groups that received some form of controlling intervention. These results represent different

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[3] The three studies that had missing data used path analysis to investigate the relationships of interest and did not provide correlation matrices or covariance matrices that could be used to calculate the required correlations.

comparisons that cannot be meaningfully combined. In contrast, as long as the variables included in two correlational studies are the same, the results are comparable. As a result of the research design criterion, 17 research reports were excluded, 54 research reports, all of which involved correlational designs, were kept.

The next inclusion criterion pertained to the characteristics of the samples used in each research report. Only samples consisting of students from normal populations of elementary, juniour high, high school or post-secondary levels of education were used in the synthesis. For example, studies that investigated the effect of autonomy support on educational outcomes for samples that consisted of only gifted students, learning disabled students, or students with a specific skill set were not included in the meta-analysis. As a result of this inclusion criterion, 7 research reports were excluded from the analysis because these reports used samples that were identified as either athletes, learning disabled students, or behaviourally disordered students. For example, one study involving athletes excluded because athletes represent a unique population of individuals who are voluntarily learning and already have a high level of skill, which might introduce bias into the interpretations of the relationship between perceived autonomy support and intrinsic motivation or performance. Samples from learning disabled or behaviourally disordered populations were excluded from the analysis because of the difficulty in generalizing results about the relationship between autonomy support and educational outcomes to a restricted sample represented by so few effect sizes. Although these sample characteristics might function as moderator variables, there were too few individual samples and effect sizes to allow for reliable moderator analysis. It should also be noted that the country from which the samples were drawn was not used to restrict inclusion in the meta-analysis because, as noted in the literature review, investigations of the relationship between perceived autonomy support and related educational outcomes with samples from countries outside of

North America have revealed similar results to those produced with North American samples. Therefore, after excluding non-correlational studies and studies that did not meet the sampling criteria, 47 research reports remained representing 58 individual samples[4] and 221 different effect sizes.

Next, restrictions were placed on the key dependent variables investigated for each sample. In order to be included in the meta analysis, research reports had to identify any one or combination of the following variables as the dependent variable(s): academic performance, cognitive engagement, external regulation, introjected regulation, identified regulation, intrinsic motivation, perceived competence, and self-determination. These variables were selected because they represent the most commonly investigated dependent variables in the indentified set of studies. Too few studies investigated the relationship between autonomy support and any other dependent variable (e.g. a-motivation) to warrant inclusion. Based on this criterion, a total of 30 effect sizes were excluded from the synthesis. Prior to describing the final inclusion criterion, a description is provided for how each of the dependent variables was operationalized for studies included in the meta-analysis.

First, academic performance was operationalized using course grades, GPA, standardized achievement tests, or some form of domain specific exam. Second, cognitive engagement was operationalized by learning strategy scales and behavioural scales like the Learning Strategies subscale of the Goal Orientation and Learning Strategies Survey (Dowson & McInerney, 2004) and the Approaches to Learning survey (Miller, Greene, Montalvo, Ravindran, & Nicholls, 1996). These scales measure engagement and also the quality of engagement. External regulation, Introjected regulation, and identified regulation were exclusively measured

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[4] Some research reports investigated the relationship between autonomy support and the educational outcomes for more than one sample.

using the Self-Regulation Questionnaire (SRQ; Ryan & Connell, 1989) or slightly modified domain specific versions of the SRQ. Higher scores on the individual subscales of the SRQ indicate a stronger endorsement of that regulatory style. Although intrinsic motivation was most frequently measured using the intrinsic motivation subscale of the SRQ, in some cases alternative scales were used. Alternative scales included the Intrinsic Versus Extrinsic Orientation in the Classroom questionnaire (Harter, 1981), the intrinsic subscale of the Motivated Strategies for Learning Questionnaire (Pintrich et al., 1987), and the intrinsic motivation subscale of the Perceived Locus of Causality Scale (Goudas, Biddle, & Cox, 1994). Self-determination was operationalized by a composite score of the subscales of the SRQ referred to as the Self-determination Index (SDI), or as it is some times referred, the Relative Autonomy Index (RAI). Finally, perceived competence was most typically measured using the Scholastic Competence subscale of the Self-Perception Profile for Children (SPPC; Harter, 1985).

The final inclusion criterion pertained to how autonomy support was operationalized within each research report. In order to be included in the meta-analysis, autonomy support had to be measured using a self-report scale of *perceived teacher autonomy support* or a self-report scale of *perceived parental autonomy support* administered to the child or student. Studies that operationalized autonomy support using self-report scales administered to parents and teachers, objective measures of teacher or parent interviews, or third party objective ratings of teacher or parent behaviour, were excluded from the meta-analysis because as noted by Deci and Ryan (1985) and reiterated later by Vallerand, Fortier, and Guay (1997), "it is not the behavior of others per se that influences one's motivation but rather one's perceptions of such behavior (p. 1164)." Further, by focusing on one type of measurement device, the variation in results due to the type of measurement device employed is substantially reduced.

Examples of scales that were used to measure perceived teacher autonomy support in the selected studies include the Learning Climate Questionnaire (Williams & Deci, 1998) and the Origin Climate Questionnaire (deCharms, 1976), which are specifically designed to measure students' perceptions of receiving support for their autonomy based on how their teacher behaves. Perceived parental autonomy support scales used in the selected studies include the Children's Perceptions of Parents Scale (Grolnick, Ryan , & Deci, 1991) and the Perceptions of Parents Scale (Robbins, 1994). Again, these scales are designed to measure how autonomy supportive children's views of their parent's autonomy supportive behaviour with higher scores reflecting stronger perceptions of autonomy support. Samples administered modified versions of these scales that were designed to suit specific educational domains or specific educational levels were also deemed acceptable and therefore included in the synthesis. As a consequence of the measurement criterion placed on the independent variable, a total of 33 effects sizes from 12 samples and 9 studies were excluded from the report. The final sample included 38 research reports representing 41 individual samples and 158 effect sizes. The next section presents a description of the survey procedures used to code the 158 identified effect sizes.

Survey Protocol

In this section a list of the information collected for each of the research reports included in the meta-analysis is provided, aspects of the coding process are described, the type of effect size data that was collected is explained, and an overview of coding reliability techniques is provided.

Information Retrieved from Studies

The following five categories of information were included in the database for the meta-analysis: i) report characteristics, ii) sample characteristics, iii) autonomy support characteristics,

iv) outcome characteristics, and v) effect size characteristics. Table 1 shows the characteristics of the studies that were coded[5].

Table 1

Information Retrieved From Studies

Report Characteristics

1. Author name
2. Year
3. Type of publication (journal article, dissertation, masters thesis, conference paper)
4. Design type (correlational, between group experimental design)

Sample Characteristics

1. Sample size
2. Gender (male, female, mixed)
3. Sample label (elementary (K-6), jr. high (7-9), sr. high (10-12), elementary-jr. high (K-9), jr-sr. high (7-12), post-secondary (>12))
4. Grade
5. Ability label (none, average, general, mixed, learning disabled, behaviourally disordered, emotional handicap)
6. Socio-economic status (low, low-middle, middle, middle-high, high, mixed, no ses information)
7. Age
8. Ethnicity (Caucasian, Chinese, Hispanic, African-American, Asian, other, not specified)
9. Location (North America, Western Europe, Northern Asia, Eastern Asia, Southeast Asia, Middle east)
10. Country
11. Setting (school, sport, lab, home)

Autonomy Support Characteristics

1. Domain (general, mathematics, science, english-language arts, physical education, other)
2. Agent of support (both parents, teacher, coach, mother, father, researcher)
3. Type of autonomy support measure (self-report perceived autonomy support, self-report perception of being controlled, motivation orientation)
4. Type of scale (existing, created, N/A)
5. Name of measure or Type of manipulation
6. Type of autonomy support behaviour (multidimensional, offering choice, attending to student voice, creating relevance, providing encouragement)

Outcome Characteristics

1. Outcome (a-motivation, ability-effort attribution, academic competence, academic performance, anxiety, cognitive engagement, creativity, deep processing, effort, engagement, enjoyment, external regulation, extrinsic motivation, free choice

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[5] Table 1 shows all information collected on the initial population of studies. Not all information was applicable to the studies that were selected for meta-analysis.

intrinsic motivation, grade orientation, identified regulation, interest, intrinsic motivation, introjected regulation, leisure-time activity, negative emotions, perceived autonomy, perceived competence, perceived control over learning, perceived relatedness, persistence, positive emotions, restricted engagement, rote learning, self-determination, subsequent learning, superficial processing, task performance)

2. Type of scale or Type of task (Type of scale – existing, created, single item, behavioural measure, course grade, GPA, standardized test, other)
3. Name of measure

Effect Size Characteristics

1. Reported effect size
2. Type of effect size (mean difference, bivariate correlation)
3. Transformed effect size
4. Standard error of the effect size
5. Inverse variance weight
6. Direction of effect

Of the 30 codes collected for each report, one involved some subjective judgment. Specifically, coding the type of autonomy supportive behaviour (this is where the students were asked to evaluate the autonomy support provided by their parents or teachers) required making a decision about which of five categories the behaviour represented. The five categories of autonomy support were identified from two primary sources. First, in their article describing autonomy support and how it relates to the study of social psychology and personality, Deci and Ryan (1987) identified the provision of choice as the primary means by which autonomy can be supported. Second, in a more focused review of research investigating autonomy support within an education context, Reeve (2002) classified autonomy supportive behaviour into four categories: (a) being flexible, which according to Reeve is synonymous with providing more opportunities for choice as identified by Deci and Ryan (1987), (b) motivating through interest, which for the purposes of coding was termed creating relevance, (c) being supportive by offering encouragement, and (d) being responsive by attending to student voice. A fifth category was developed because in most cases the autonomy support measure did not represent a single category and required including measures from all four categories. For situations like this, the autonomy support measure was classified as multidimensional. This

study characteristic was initially coded because of the potential for it to be investigated as a moderator variable in the analysis. However, most effect sizes in the meta-analysis were calculated based on multidimensional measures of autonomy support (144 out of 158, 91%) with the remaining 9% split between offering choice (n=4), attending to student voice (n=5), providing encouragement (n=5), and creating relevance (n=0). The lack of specificity of the autonomy support measures used in the studies included in the meta-analysis did not permit moderation analysis to be conducted based on this variable.

Effect Size Data

The product-moment correlation was used to estimate the effect of perceived autonomy support on the dependent variables. The product-moment effect size statistic is inherently standardized, varying between -1 and 1 with higher absolute values representing a stronger association between the variables and smaller absolute values representing a weaker association. Although the correlation coefficient is standardized and could simply be recorded directly as the effect size statistic, it must be transformed using Fisher's *Zr* transform because the sampling distribution of correlation coefficients tends to be negatively skewed and can lead to an inflated type one error rate when testing for homogeneity, which is described later (Alexander, Scozzaro, & Borodkin, 1989). Recorded correlation coefficients were transformed using Fisher's *Zr* transform using equation 1 (Hedges & Olkin, 1985 as cited in Lipsey and Wilson, 2001):

$$ES_{Zr\,i} = 0.5\log_e\left[\frac{(1+r_i)}{(1-r_i)}\right], \qquad (1)$$

where ES_{Zr} is the transformed effect size, *r* is the correlation coefficient, and *i* indexes studies.

The standard error for each transformed effect size, SE_{Zr}, was then calculated using equation 2:

$$SE_{Zr_i} = \frac{1}{\sqrt{n_i - 3}} \quad (2)$$

where n_i is the total sample size for study i. Finally, the standard error was used to calculate the inverse variance weight, w_{Zr}, for each transformed effect size statistic using equation 3:

$$w_{Zr_i} = \frac{1}{(SE_{Zr_i})^2} \quad (3)$$

The inverse variance weight is used to combine multiple effect size statistics so that effect sizes that are based on larger subject sample sizes contribute more to the overall effect size than those based on smaller subject samples. These effect sizes have less sampling error and as a result should be weighted accordingly.

Coding reliability

In order to establish coding reliability, a random sampling procedure similar to the one used by Cameron and Pierce (1994) in their meta-analysis of the effects of rewards on intrinsic motivation was applied. This procedure was employed because not only are coding inconsistencies identified, steps are taken to rectify disagreements. In Cameron and Pierce's procedure, ten research reports from the population of included studies that were originally coded by the first author were randomly selected to be re-coded by the second author, discrepancies were discussed, and steps were taken to resolve inconsistencies. In the present meta-analysis a second person was unavailable for the recoding process and as a result, the author conducted the recoding. Although steps were taken to stagger the initial coding and recoding process, this is a potential limitation of the study since reliability estimates could be inflated as only one person assigned codes. Nonetheless, the results from the recoding process revealed that out of 330 codes from the ten studies that were selected for re-coding 4 were in

disagreement representing an intra-rater agreement of 0.99. Of the four codes that were in disagreement, two were attributable to data entry error, one was the result of a calculation error, and one stemmed from an incorrect interpretation of the autonomy support measure. For the discrepancy in the interpretation of the autonomy support measure, careful re-examination of how the study defined autonomy support was employed and the disagreement was resolved. The next section presents a description of the statistical methods of data integration for meta-analysis.

Statistical Methods of Data Integration

Six steps are required to analyze effect size data in a meta-analysis. First, a definition of effect size independence must be established so that statistically dependent effect sizes are not combined to produce inaccurate average effect sizes. Second, subgroups of effect sizes must be identified to allow for the appropriate level of distribution analysis. Third, for each subgroup of effect sizes, an outlier analysis must be conducted to identify extreme effect size statistics that can be adjusted to the nearest neighbor, a process known as Winsorizing (Lipsey & Wilson, 2001). Fourth, the weighted mean effect size for the identified sub groups of effect sizes are calculated and tested for significance. Fifth, the distributions of effect sizes are subjected to homogeneity tests. Sixth, hypothesized moderating variables are used to try to explain heterogeneous effect size distributions. The details of how each step was carried out for the present meta-analysis is provided next.

Defining independence

According to Lipsey and Wilson (2001), individual subject samples can be used to define effect size independence in a meta-analysis. For example, a single research report might include correlational analysis with Chinese students and North American students resulting in two correlation coefficients for the relationship between perceived autonomy support and academic

performance. For this example, the two correlation coefficients reported for the Chinese and North American students can be coded as independent effect sizes. Alternatively, a research report might report two correlation coefficients for a single sample. For example, the researcher might operationalize academic performance using both GPA and scores on achievement tests or it could be the case that a researcher reports individual effect size statistics for the effect of perceived maternal autonomy support and perceived paternal autonomy support on academic performance. In both cases, independence cannot be assumed because two effect sizes have been produced to describe a single sample, therefore a decision had to be made about how to record the effect sizes for the samples. In situations where more than one correlation coefficient was reported for the same relationship for a single subject sample, each correlation coefficient was coded but the effect sizes were averaged to produce a single independent effect size for the sample (Lipsey & Wilson, 2001).

Identifying Groups

Prior to calculating mean effect sizes or conducting outlier analysis, groupings of effect size statistics that could be meaningfully combined were defined. The first characteristic used as a basis for forming groups that could be meta-analyzed was the outcome variable associated with each effect size statistic. This resulted in eight groups of effect sizes or eight separate meta-analyses (i.e. one for each effect of percieved autonomy support on academic performance, cognitive engagement, external regulation, introjected regulation, identified regulation, intrinsic motivation, self-determination, and perceived competence, respectively). Second, within the eight dependent variable groups, the effect size statistics were split based on agent of support. As a result, within each of the eight dependent variable groupings, effect sizes were classified based on those for which the agent of support was identified as the teacher and

those for which the agent of support was identified as the parents[6]. The second level of classification resulted in a total of 8x2 meta-analysis groups, eight summarizing the relationship between perceived parental autonomy support and the dependent variables and eight summarizing the relationship between perceived teacher autonomy support and the dependent variables.

Within the 16 separate meta-analyses, moderation subgroups based on educational level were formed. These subgroups did not represent separate meta-analyses but were formed to facilitate outlier and moderator analysis. Effect sizes were classified based on one of four levels of education: elementary (K-6), jr. high (7-9), sr. high (10-12), jr-sr. high (7-12), and post-secondary (>12).

Outlier Analysis

A method of identifying outliers (Beal, Corey, & Dunlap, 2002)[7] was applied to each subgroup of effect sizes associated with one of the four levels of education for each of the 16 separate meta-analyses. The first step involved transforming correlation coefficients using Fisher's Zr transform (equation 1). This transformation removes the negative skew in the correlation coefficient sampling distribution, which can lead to an over-identification of small correlations as outliers (Beal, Corey, & Dunlap, 2002). The second step is to calculate the sampling error variance of effect size from study *i*, ES_i, using equation 4:

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[6] Effect sizes were classified based according to agent of support because for some of the research reports included in the meta-analysis the correlations between perceived parental and perceived teacher autonomy support and the dependent variables, respectively, were calculated using the same subject sample, which created an unwanted dependency. Rather than average the effect size across differing agents of support and lose data, the studies were split into groups that could be analyzed separately.

[7] Beal, Corey and Dunlap's (2002) method for identifying outliers represents a modified version of Huffcut and Arthur's outlier procedure (1995). While Huffcut and Arthur's method takes into account subject sample size when calculating potential outliers, the Beal et al. modification eliminates any bias introduced based on the tendency for sampling distributions of the correlation coefficient to have slightly negatively skewed distributions.

$$Var(ES_i) = \frac{(1-(\overline{ES}_{Zr_j \ \ w/o \ \ study \ \ i})^2)^2}{(n_i - 1)}, \tag{4}$$

where $\overline{ES}_{Zr_j \ \ w/o \ \ study \ \ i}$ is the mean transformed effect size of the moderation subgroup *j* with the effect size from study *i* removed, where *j* indexes the moderation subgroup, and n_i is the sample size of study *i*. The third step is to calculate the sampling error variance of the mean transformed effect size of moderation subgroup *j* with effect size *i* removed using equation 5,

$$Var(\overline{ES}_{Zr_j \ \ w/o \ \ study \ \ i}) = \frac{(1-(\overline{ES}_{Zr_j \ \ w/o \ \ study \ \ i})^2)^2}{(N_j - 1)(k-1)}, \tag{5}$$

where

$$\overline{N_j} = \frac{\sum_{i=1}^{k} N_j - n_i}{k-1} \tag{6}$$

and *k* equals the number of effect sizes in each moderation subgroup, and N_j is the total sample size of the studies that make up each moderation subgroup. Next, the sample adjusted meta-analytic deviancy (SAMD) statistic is calculated for each effect size using equation 7:

$$SAMD = \frac{(ES_i - \overline{ES}_{Zr_j \ \ w/o \ \ study \ \ i})}{\sqrt{Var(ES_i) + Var(\overline{ES}_{Zr_j \ \ w/o \ \ study \ \ i})}} \tag{7}$$

where the numerator is the raw difference score between the effect size from study *i* and the mean transformed effect size of the moderation subgroup *j* with effect size *i* removed, and the denominator is the square root of the variance of this difference. The SAMD statistic approximates a t-distribution which means outliers can be identified by comparing the absolute SAMD statistic to a critical t-value (Beal et al., 2002). Absolute SAMD statistics that are larger than the critical t value are identified as outliers. For the purpose of this meta-analysis, the critical value for each subgroup, *j*, was identified with an α level of 0.05 and $k - 1$ degrees of freedom. For example, for a subgroup containing nine independent effect size statistics, the

critical t-value would be set to $t_{\alpha=.05,df=8} = 2.31$. Using this method, the SAMD statistic for each effect size was calculated and compared to a corresponding critical t value. Identifying outliers is an iterative process, therefore, the first iteration involved identifying the largest outlier for each subgroup, *j*, and setting the outlier to have a value identical to the next nearest effect size, a process know as Windsorizing (Lipsey & Wilson, 2001). The second iteration involved re-running the analysis and identifying additional outliers to be set to the next nearest effect size. The iterative process was repeated until all outliers had been eliminated. After all outliers were eliminated, average effect sizes calculation could proceed.

Calculating Weighted Mean Effect Sizes

In order to calculate the average effect size statistic for each meta-analytic group, $\overline{ES}_{Zr}$, the sum of the product of the inverse variance weights, w_{Zr}, and the transformed effect size statistics, ES_{Zr}, is divided by the sum of all inverse variance weights in each meta-analysis group using equation 8 (Lipsey & Wilson, 2001):

$$\overline{ES}_{Zr_l} = \frac{\sum_{i=1}^{m} w_{Zr_{li}}(ES_{Zr_{li}})}{\sum_{i=1}^{m} w_{Zr_{li}}}, \tag{8}$$

where l indexes the meta-analysis group, *i* indexes studies, and *m* is the total number of effect sizes within each meta-analysis group, l. Next, the standard error of the average transformed effect size for each meta-analysis group, $SE_{\overline{ES}_{Zr}}$, which is used to calculate 95% confidence intervals, is calculated using equation 9:

$$SE_{\overline{ES}_{Zr_l}} = \sqrt{\frac{1}{\sum_{i=1}^{m} w_{Zr_{li}}}}, \tag{9}$$

For ease of interpretation, average effect size statistics and the upper and lower limits confidence intervals were converted using equation 10 (Glass & Hopkins, 1996):

$$\bar{r} = \frac{e^{2\overline{ES}_{z_i}} - 1}{e^{2\overline{ES}_{z_i}} + 1} \quad (10)$$

Confidence intervals containing zero were used to support the inference that the average correlation coefficient was not significant. Alternatively, confidence intervals that did not contain zero were used to support the inference that the average correlation coefficient was significant.

The confidence intervals were used to make comparisons between the average effect size statistic for each of the eight dependent variables collapsed across education level for parental autonomy support and teacher autonomy support. By comparing the eight average effect size statistics from the studies that used perceived parental autonomy support as the primary independent variable to the eight average effect size statistics to the studies that used perceived teacher autonomy support as the primary independent variable, differences in the strength of the perceived autonomy support relationships based on agent of support were determined. If the confidence intervals of the effect size statistics overlapped, no difference between the relationships was identified. Alternatively, if the intervals did not overlap, the relationships were identified as being significantly different. In the next stage of analysis, homogeneity tests the average effect size estimates were conducted (Hedges, 1982; Rosenthal & Rubin, 1982 as cited in Lipsey & Wilson, 2001).

Homogeneity Analysis

Prior to conducting homogeneity analysis, the model used to describe variability in the observed effect size distributions had to be specified (Lipsey & Wilson, 2001). A choice between random effects, fixed effects, and mixed effects models had to be made. In a random effects

model, sampling error and random differences among the effect sizes are sources of variability. Assuming a random effects model requires adding the variance due to random differences among effect sizes to the standard error of each effect size. This results in new inverse variance weights, which affect the calculation of the average effect size, its standard error, and the confidence intervals for the resulting average effect sizes. In a fixed effects model, variability is attributed to sampling error and the result of systematic differences among effect sizes. A fixed effects assumption requires the meta-analyst to demonstrate that the variance beyond that which is attributed to sampling error is the result of a moderator variable that systematically differentiates effect sizes into subgroups. Finally, a mixed effects model assumes variance in the observed effect sizes is attributable in part to random differences in the effect sizes, systematic differences, and sampling error. By assuming a mixed effects model, the meta-analyst splits the effect sizes into fixed subgroups, calculates the random error associated with each subgroup, and adds the random error to each effect size in the corresponding subgroup. The result is new standard errors for each effect size in the meta-analysis, which results in new inverse variance weights, new average effect sizes, and new standard errors. For the purpose of the present meta-analysis a mixed model was assumed because it was hypothesized that each effect size distribution for the 16 meta-analyses would be found to be heterogeneous. Further, it was hypothesized that the heterogeneity would be due to the level of education, implying a fixed effect. According to Lipsey and Wilson (2001), homogeneity tests on samples containing small numbers of effect sizes lack statistical power so in order to increase the power of the homogeneity test, random effects should be included in the model. The procedures used to conduct homogeneity tests when assuming a mixed effects model are described next.

Homogeneity tests are based on the *Q* statistic and are used to determine whether the amount of variance in the distribution of effect sizes is greater than what is expected due to

sampling error alone (Hedges & Olkin, 1985). The *Q* statistic is distributed as a chi-square with $m - 1$ degrees of freedom where m is the number of effect sizes in each meta-analysis group, l. The formula used to calculate *Q* for each meta-analysis group is shown in equation 11:

$$Q_l = \sum_{i=1}^{m} w_{Zr_{il}} (ES_{Zr_{il}} - \overline{ES}_{Zr_l})^2, \tag{11}$$

If the calculated Q_l for a given set of effect sizes is less than the critical value for a chi-square distribution with $m - 1$ degrees of freedom, the variance in the observed effect sizes is most likely due to sampling error alone and the effect sizes are said to be homogeneous. Alternatively, if the calculated Q_l statistic for a given set of effect sizes is greater than the critical value, the effect sizes are said to be heterogeneous.

To conduct homogeneity analyses under a mixed effects model, the effect sizes for each meta-analysis group are divided into moderation subgroups based on an identifiable factor, *j*. For the present meta-analysis, the identified factor was educational level. Once split, the within groups homogeneity statistic for each subgroup, $Q_{w_{lj}}$, is calculated and used to make adjustments to account for the random error associated with each moderation subgroup. The method of moments (Raudenbush, 1994 as described in Lipsey & Wilson, 2001) is used to estimate the random effects variance, υ_θ, for each moderation subgroup, *j*, using equation 12:

$$\upsilon_{\theta lj} = \frac{Q_{w_{lj}} - (k-1)}{\sum_{i=1}^{k} w_{Zr_{ij}} - \sum_{i=1}^{k} w_{Zr_{ij}}^{\ 2} \Big/ \sum_{i=1}^{k} w_{Zr_{ij}}}. \tag{12}$$

Recall that *i* indexes studies, l indexes the meta-analysis group, *j* indexes the moderation subgroup, and *k* is the total number of effect sizes in each moderation subgroup. The estimates of the random effects variance for each subgroup are then added to the standard error originally calculated for each study using equation 9, and new inverse variance weights are produced using equation 3. The new inverse variance weights are used to recalculate the

average effect size statistics along with the associated standard error for each group of effect sizes collapsed across educational level. Homogeneity tests are run on the new average effects sizes, and given a calculated Q_t less than the critical value, the null hypothesis (i.e. the observed effect sizes are homogeneous) is accepted. Alternatively, if the calculated Q_t is greater than the critical value, the null hypothesis is rejected and moderation analysis is conducted.

Moderation Analysis

In moderation analysis, the homogeneity statistic for each meta-analysis group, Q_t, is allocated to a between groups component, Q_b, and a within groups component, Q_w, similar to a one-way ANOVA (Hedges, 1982 as cited in Lipsey & Wilson, 2001). The within groups component is the sum of the homogeneity statistics calculated for each moderation subgroup, Q_{wj}, and the between groups component is simply the difference between the overall homogeneity statistic and the within groups component, $Q_t - Q_w$. The degrees of freedom for Q_b is $j - 1$, where j is the number of moderation subgroups. The degrees of freedom for Q_w is $m - j$, where m is the total number of effect sizes in the meta-analysis group. Moderation is shown to exist when Q_b is significantly greater relative to Q_w. Next, the individual component for each moderation subgroup, Q_{wj}, is examined to determine if the moderator has completely accounted for the variance above and beyond sampling error variance. A non-significant Q_{wj} means that the effect sizes within each subgroup are homogeneous and therefore are determined to be from the same parent population, whereas a significant Q_{wj} indicates that statistically significant differences exist among the observed effect sizes used to calculate the weighted mean effect size for the subgroup and the moderator was not able to account for all of the variance above and beyond that which is attributed to sampling error. For the present meta-analysis, level of education was hypothesized to be the variable of interest for moderation analysis. The results from the meta-analysis are described next.

CHAPTER III - RESULTS

The literature search and applied inclusion criterion led to 38 research reports investigating the relationship between perceived autonomy support and educational outcomes. From the 38 reports, 49 individual samples were identified that represented 158 effect sizes. Table 2 provides a complete list of the 38 research reports organized by author along with the type of publication, sample size, educational level, sample location, subject domain, the agent of support, the type of autonomy support behaviour, the type of scale used to measure autonomy support, the outcome variable, the type of outcome scale, the coded correlation coefficients, and the transformed effect size statistic. Table 3 provides a breakdown of how the effect sizes were distributed across the outcome variables as a function of the two types of perceived autonomy support. Each cell in table 3 represents sets of effect sizes that can be combined using meta-analysis techniques.

Table 2

Characteristics of Correlational Studies Included in the Meta-analysis

Author (year)	Typ Pub	*n*	Ed Lev	Smp Loc	Dmn	Agnt Sup	Typ AS	Typ Scl	Otcm	Typ Scl	*r*	ES_{Zr}
Black & Deci (2000)	J	137	PS	NA	SCI	T	MD	EXS	PCMP	CS	0.43	0.46
									INMT	CS	0.28	0.29
									ACP	OTH	0.29[c]	0.30
Boggiano (1998)	J	137	EL	NA	GEN	T	MD	EXS	INMT	EXS	0.26	0.27
									PCMP	EXS	0.35	0.37
Bronstien (2005)	J	77	JH	NA	GEN	P	MD	EXS	ACP	OTH	0.27[b,c]	0.28
									PCMP	EXS	0.25[b]	0.25
									INMT	EXS	0.23[b]	0.23
Chirkov (2001) smp 1	J	116	SH	NA	GEN	P	MD	EXS	EXREG	EXS	-0.21	-0.21
									INREG	EXS	0.06	0.06
									IDREG	EXS	0.38	0.40
									INMT	EXS	0.14	0.14
	J	116	SH	NA	GEN	T	MD	EXS	EXREG	EXS	-0.25	-0.26
									INREG	EXS	0.03	0.03
									IDREG	EXS	0.36	0.38
									INMT	EXS	0.60	0.69

Table 2

Characteristics of Correlational Studies Included in the Meta-analysis

Author (year)	Typ Pub	*n*	Ed Lev	Smp Loc	Dmn	Agnt Sup	Typ AS	Typ Scl	Otcm	Typ Scl	*r*	ES_{Zr}
Chirkov (2001) smp 2	J	120	SH	EE	GEN	P	MD	EXS	EXREG	EXS	-0.26	-0.27
									INREG	EXS	0.15	0.15
									IDREG	EXS	0.47	0.51
									INMT	EXS	0.16	0.16
	J	120	SH	EE	GEN	T	MD	EXS	EXREG	EXS	-0.28	-0.29
									INREG	EXS	0.08	0.08
									IDREG	EXS	0.43	0.46
									INMT	EXS	0.48	0.52
Dai (1998) smp 1	D	153	JSH	NA	GEN	P	MD	EXS	INREG	EXS	-0.25	-0.26
									IDREG	EXS	0.21	0.21
									INMT	EXS	0.20	0.20
									CENG	CS	0.19	0.19
									ACP	GPA	0.12	0.12
Dai (1998) smp 2	D	206	SH	EA	GEN	P	MD	EXS	INREG	EXS	-0.31	0.06[d]
									IDREG	EXS	0.41	0.44
									INMT	EXS	0.22	0.22
									CENG	CS	0.25	0.26
									ACP	GPA	0.07	0.07
d'Ailly (2003)	J	806	EL	EA	GEN	T	MD	EXS	SLFDT	EXS	0.12	0.12
									ACP	CG	0.07	0.07
	J	806	EL	EA	GEN	P	MD	EXS	SLFDT	EXS	0.18[a]	0.18
									ACP	CG	0.01[a]	0.01
Frauts (2001) smp 1	M	218	PS	NA	PED	T	MD	EXS	PCMP	EXS	0.11	0.11
Frauts (2001) smp 2	M	180	PS	NA	PED	T	MD	EXS	PCMP	EXS	0.01	0.11[d]
Garcia & Pintrich (1996)	J	339	PS	NA	GEN	T	CH	EXS	INMT	EXS	0.58	0.66
									ACP	CG	0.11	0.11
Ginsburg & Bronstein (1993)	J	90	EL	NA	GEN	P	MD	CS	INMT	EXS	0.11[b]	0.11
									ACP	OTH	0.08[b,c]	0.08
Greene et al. (2004)	J	220	SH	NA	ELA	T	MD	EXS	ACP	CG	0.24	0.24
									CENG	EXS	0.31	0.32
Grolnick, Ryan, & Deci (1991)	J	456	EL	NA	GEN	P	MD	CS	PCMP	EXS	0.24[a]	0.24
									SLFDT	EXS	0.22[a]	0.22
									ACP	OTH	0.05[a,c]	0.05
Grolnick et al. (2002)	J	60	EL	NA	OTH	P	MD	EXS	ACP	CG	0.34[a]	0.19[d]
Hagger et al. (2003)	J	295	JSH	NA	PED	T	MD	EXS	EXREG	CS	0.02	0.02

Table 2

Characteristics of Correlational Studies Included in the Meta-analysis

Author (year)	Typ Pub	*n*	Ed Lev	Smp Loc	Dmn	Agnt Sup	Typ AS	Typ Scl	Otcm	Typ Scl	*r*	ES_{Zr}
									INREG	EXS	0.09	0.09
									IDREG	EXS	0.38	0.40
									INMT	EXS	0.33	0.35
Hardre & Reeve (2003)	J	483	JSH	NA	GEN	T	MD	CS	EXREG	EXS	-0.11[b]	-0.11
									IDREG	EXS	0.38[b]	0.40
									INMT	EXS	0.40[b]	0.42
									PCMP	SI	0.24[b]	0.24
									ACP	CG	0.09[b]	0.09
Lavigne, et al. (2007) smp 1	J	342	SH	NA	SCI	T	AV	CS	SLFDT	CS	0.20	0.20
									PCMP	CS	0.28	0.29
Lavigne, et al. (2007) smp 2	J	357	SH	NA	SCI	T	AV	CS	SLFDT	CS	0.09	0.20[d]
									PCMP	CS	0.23	0.23
Leung & Kwan (1998)	J	404	JH	EA	GEN	P	EN	CS	INMT	CS	0.24	0.24
									PCMP	EXS	0.16	0.16
Niemiec et al. (2006)	J	201	PS	WE	GEN	P	MD	EXS	SLFDT	EXS	0.33[c]	0.34
Ntoumanis (2005)	J	301	SH	WE	PED	T	MD	EXS	INREG	EXS	0.22	0.22
									PCMP	EXS	0.58	0.44[d]
									EXREG	EXS	-0.26	-0.27
									IDREG	EXS	0.51	0.56
									INMT	EXS	0.51	0.56
Ommundsen & Kvalo (2007)	J	194	SH	WE	PED	T	MD	CS	PCMP	EXS	0.41	0.44
									SLFDT	EXS	0.40	0.42
									INMT	EXS	0.58	0.66
Padmawidjaja (1998) smp 1	D	329	EL	SEA	GEN	P	MD	EXS	ACP	CG	0.09	0.09
									PCMP	EXS	0.07	0.07
									SLFDT	EXS	0.02	0.02
Padmawidjaja (1998) smp 2	D	129	EL	EA	GEN	P	MD	EXS	ACP	CG	0.19	0.19
									PCMP	EXS	0.15	0.15
									SLFDT	EXS	0.16	0.16
Padmawidjaja (1998) smp 3	D	120	EL	NA	GEN	P	MD	EXS	ACP	CG	0.15	0.15
									PCMP	EXS	0.06	0.06
									SLFDT	EXS	0.11	0.11
Perencevich (2004)	D	244	EL	NA	ELA	T	MD	CS	CENG	EXS	0.23	0.23
									ACP	CG	0.05	0.05

Table 2

Characteristics of Correlational Studies Included in the Meta-analysis

Author (year)	Typ Pub	*n*	Ed Lev	Smp Loc	Dmn	Agnt Sup	Typ AS	Typ Scl	Otcm	Typ Scl	*r*	ES_{Zr}
Robbins (1994)	D	123	PS	NA	GEN	P	MD	CS	SLFDT	EXS	0.16[a]	0.16
Ryan & Grolnick (1986) smp 1	J	124	EL	NA	GEN	T	MD	EXS	INMT	EXS	0.22	0.22
									PCMP	EXS	0.27	0.28
Ryan & Grolnick (1986) smp 2	J	587	EL	NA	GEN	T	MD	EXS	INMT	EXS	0.37	0.39
									PCMP	EXS	0.33	0.34
Ryan & Connell (1989) smp 1	J	113	EL	NA	GEN	T	MD	EXS	EXREG	CS	-0.19	-0.19
									INREG	CS	0.02	0.02
									IDREG	CS	0.20	0.20
									INMT	CS	0.41	0.44
Ryan & Connell (1989) smp 2	J	450	EL	NA	GEN	T	MD	EXS	EXREG	CS	-0.04	-0.04
									INREG	CS	0.18	0.18
									IDREG	CS	0.29	0.30
									INMT	CS	0.22	0.22
Sheldon & Krieger (2007)	J	198	PS	NA	OTH	T	MD	EXS	PCMP	EXS	0.48	0.46[d]
									ACP	GPA	0.13	0.13
									SLFDT	CS	0.35	0.37
Shih (2008)	J	343	JH	EA	GEN	T	MD	EXS	EXREG	EXS	0.06	0.06
									INREG	EXS	0.36	0.38
									IDREG	EXS	0.56	0.63
									INMT	EXS	0.40	0.42
									CENG	CS	0.55	0.62
Skinner & Belmont (1993)	J	144	EL	NA	GEN	T	MD	EXS	CENG	CS	0.56[c]	0.63
Soenens & Vansteenkiste (2005) smp 1	J	328	SH	WE	GEN	P	MD	CS	SLFDT	EXS	0.15[a]	0.15
									PCMP	EXS	0.14[a]	0.14
									ACP	GPA	0.12[a]	0.12
	J	328	SH	WE	GEN	T	MD	EXS	SLFDT	EXS	0.29	0.30
									PCMP	EXS	0.06	0.23[d]
									ACP	GPA	0.02	0.02
Soenens & Vansteenkiste (2005) smp 2	J	285	SH	WE	GEN	P	MD	CS	SLFDT	EXS	0.20[a]	0.20
									ACP	GPA	0.13[a]	0.13
	J	285	SH	WE	GEN	T	MD	EXS	SLFDT	EXS	0.25	0.26
									ACP	GPA	0.19	0.19

Table 2

Characteristics of Correlational Studies Included in the Meta-analysis

Author (year)	Typ Pub	*n*	Ed Lev	Smp Loc	Dmn	Agnt Sup	Typ AS	Typ Scl	Otcm	Typ Scl	*r*	ES_{Zr}
Standage, Duda, & Ntoumanis (2003)	J	328	JH	WE	PED	T	MD	EXS	PCMP	EXS	0.30	0.31
									INREG	EXS	0.21	0.21
									IDREG	EXS	0.38	0.40
Standage, Duda, & Ntoumanis (2006)	J	394	JH	WE	PED	T	MD	EXS	EXREG	EXS	-0.26	-0.27
									INREG	EXS	0.22	0.22
									IDREG	EXS	0.43	0.46
									INMT	EXS	0.55	0.62
									PCMP	EXS	0.38	0.40
									SLFDT	EXS	0.47	0.51
Stiller & Ryan (2002)	C	694	JH	NA	GEN	T	MD	CS	CENG	EXS	0.41	0.44
									SLFDT	EXS	0.25	0.26
	C	694	JH	NA	GEN	P	MD	CS	CENG	EXS	0.24	0.24
									SLFDT	EXS	0.15	0.15
Trouilloud et al. (2006)	J	421	JSH	WE	PED	T	MD	EXS	PCMP	EXS	0.22	0.22
Vansteenkiste et al. (2005)	J	79	PS	WE	OTH	P	MD	EXS	EXREG	EXS	-0.28	-0.29
									INMT	EXS	0.16	0.16
									SLFDT	EXS	0.37	0.39
									CENG	EXS	0.28	0.29
Vallerand, Fortier, & Gauy (1997)	J	4537	SH	NA	GEN	P	MD	EXS	SLFDT	EXS	0.53	0.20[d]
	J	4537	SH	NA	GEN	T	MD	EXS	SLFDT	EXS	0.47	0.30[d]
									PCMP	EXS	0.49	0.29[d]
Vierling, Standge, & Treasure (2007)	J	239	JSH	NA	PED	T	MD	EXS	EXREG	EXS	0.05	0.05
									INREG	EXS	0.11	0.11
									IDREG	EXS	0.22	0.22
									INMT	EXS	0.25	0.26
									PCMP	EXS	0.28	0.29
	J	239	JSH	NA	PED	P	MD	EXS	EXREG	EXS	0.14	0.14
									IDREG	EXS	0.27	0.28
									INREG	EXS	0.12	0.12
									INMT	EXS	0.37	0.39
									PCMP	EXS	0.25	0.26
Wang (2006) smp 1	J	373	JH	NA	GEN	P	MD	EXS	CENG	EXS	0.37	0.39
									ACP	GPA	0.24	0.24
Wang (2006) smp 2	J	433	JH	EA	GEN	P	MD	EXS	CENG	EXS	0.39	0.41
									ACP	GPA	0.17	0.17

Table 2

Characteristics of Correlational Studies Included in the Meta-analysis

Author (year)	Typ Pub	*n*	Ed Lev	Smp Loc	Dmn	Agnt Sup	Typ AS	Typ Scl	Otcm	Typ Scl	*r*	ES_{Zr}
Watts (2004)	D	377	JH	NA	OTH	P	MD	EXS	EXREG	EXS	-0.19	-0.19
									INREG	EXS	0.04	0.04
									IDREG	EXS	0.29	0.30
									INMT	EXS	0.35	0.37
Williams & Deci (1996) smp 1	J	91	PS	NA	OTH	T	MD	EXS	EXREG	CS	-0.14	-0.14
Williams & Deci (1996) smp 2	J	72	PS	NA	OTH	T	MD	EXS	EXREG	CS	-0.06	-0.06

Note. Smp = sample; Typ Pub = type of publication; J = journal article; D = dissertation; M = master's thesis; C = conference paper; *n* = sample size; Ed Lev = education level; EL = elementary; JH = junior high; SH = senior high; JSH = junior-senior high; PS = post-secondary; Smp Loc = sample location; NA = North America; WE = Western Europe; EE = Eastern Europe; EA = Eastern Asia; SEA = Southeast Asia; Dmn = domain; GEN = general; MTH = math; SCI = science; ELA = English/language arts; PED = physical education; OTH = other; Agnt Sup = agent of support; P = parents; T = teacher; Typ Scl = type of scale; EXS = existing scale; CS = created scale; CG = course grade; GPA = grade point average; ACH = standardized achievement test; Otcm = outcome; ACP = academic performance; CENG = cognitive engagement; EXREG = external regulation; INREG = introjected regulation; IDREG = indetified regulation; INTMT = intrinsic motivation; PCMP = perceived competence; SLFDT = self-determination *r* = bivariate correlation coefficient; [a] averaged correlations for mother and father to produce a single parental correlation; [b] averaged correlations for multiple measures the independent variable - perceived autonomy support; [c] averaged correlations for multiple measures of the dependent variable; ES_{Zr} = transformed effect size statistic; [d] identified as an outlier and adjusted to nearest transformed effect size.

Table 3

Number of Effect Sizes (m) as a Function of Educational Outcome and Agent of Support

	Educational Outcome							
Agent of Support	ACP	CENG	EXREG	INREG	IDREG	INTMT	PCMP	SLFDT
Perceived parental autonomy support	14	6	5	6	6	10	8	12
Perceived teacher autonomy support	9	5	12	10	11	16	18	10

Note. The effect sizes could not be totaled across dependent variables because some of the same samples were used to generate the effect sizes for the independent variables, which would have lead to unwanted dependencies. ACP = academic performance; CENG = cognitive engagement; EXREG = external regulation; INREG = introjected regulation; IDREG = indentified regulation; INTMT = intrinsic motivation; PCMP = perceived competence; SLFDT = Self-determination.

The 38 research reports included in the meta-analysis span the years of 1986 to 2008 with sample sizes ranging from 60 to 4537. The SAMD statistic was calculated for each effect size within each moderator subgroup of each meta-analysis group. For the relationship between perceived parental autonomy support and the academic performance of elementary students, one outlier on the right side of the distribution was identified (ES_{Zr} = 0.35 from Grolnick et al., 2002). This outlier was Winsorized[8] to the nearest neighbor, and retained for further analysis (Lipsey & Wilson, 2001). For the relationship between perceived parental autonomy support and the introjected regulation of senior high school students, one outlier on the left side (ES_{Zr} = -0.32 from Dai, 1998) of the distribution was identified and Winsorized to its nearest neighbor (ES_{Zr} = -0.26). One effect size on the right side of the distribution (ES_{Zr} = 0.59 from Vallerand, Fortier, & Gauy, 1997) was Winsorized to ES_{Zr} = 0.20 for the relationship between perceived parental autonomy support and the self-determination of senior high school students. For the relationship between perceived teacher autonomy support and the perceived competence of post-secondary students, one effect size on the left side of the distribution (ES_{Zr} = 0.01 from Frauts, 2001) was Winsorized to ES_{Zr} = 0.11. For the relationship between perceived teacher autonomy support and the perceived competence of senior high students, four effect sizes, one on the left side (ES_{Zr} = 0.06 from Soenens & Vansteenkiste, 2005) and three on the right side of the distribution (ES_{Zr} = 0.66 from Ntoumanis, 2005; ES_{Zr} = 0.54 from Vallerand, Fortier, & Gauy, 1997; and ES_{Zr} = 0.52 from Sheldon & Krieger, 2007) were Winsorized to ES_{Zr} = 0.23, ES_{Zr} = 0.44, ES_{Zr} = 0.29, and ES_{Zr} = 0.46, respectively. Finally, for the relationship between perceived teacher autonomy support and the self-determination of senior high school students, two effect sizes, one from the left side (ES_{Zr} = 0.09 from Lavigne, Vallerand, & Miquelon, 2007) and one from the right side of the distribution (ES_{Zr} = 0.51 from Vallerand, Fortier, & Gauy, 1997) were Winsorized

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[8] Adjusting outliers to the next nearest effect size.

to $ES_r = 0.20$, and $ES_r = 0.30$, respectively. For relationships with less than two observed effect sizes, no outlier analysis was conducted. For example only one study investigated the relationship between perceived parental autonomy support and academic performance for junior-senior high school students. The combined effect of perceived autonomy support on the educational outcomes is presented next.

Overall Effects of Perceived Autonomy Support

The first set of results examines the effects of perceived parental and perceived teacher autonomy support on the eight outcome variables in the synthesis. The first half of Table 4 shows the results for the relationships between perceived parental autonomy support and the eight outcome variables. The second half of Table 4 provides the results for the relationships between perceived teacher autonomy support and the eight outcome variables. A systematic description for each outcome variable is presented next.

Table 4

Results of the Analysis of the Effect of Perceived Autonomy Support on All Outcome Variables as a Function of the Agent of Support

Dependent Variable	*m*	*N*	$\overline{ES_{Zr}}$	$\bar{r}$	95% CI for $\bar{r}$		Q_b
					LL	*UL*	
With perceived parental autonomy support as the independent variable							
Academic performance	14	3905	0.1081	0.11	0.08	0.14	22.17
Cognitive engagement	6	1998	0.3035	0.29	0.25	0.34	9.96
External regulation	5	931	-0.1481	-0.15	-0.21	-0.08	23.40***
Introjected regulation	6	1271	-0.0319	-0.03	-0.09	0.03	24.87***
Identified regulation	6	1271	0.3429	0.33	0.28	0.38	10.08
Intrinsic motivation	10	1921	0.2503	0.25	0.20	0.29	11.82

Self-determination	12	8087	0.1900	0.19	0.17	0.21	18.80
Perceived competence	8	2082	0.1681	0.17	0.12	0.21	8.43
With perceived teacher autonomy support as the IV							
Academic performance	9	3040	0.1082	0.11	0.07	0.15	13.00
Cognitive engagement	5	1645	0.4838	0.45	0.39	0.51	9.45
External regulation	12	3017	-0.1070	-0.11	-0.15	-0.07	31.41***
Introjected regulation	10	2699	0.1828	0.18	0.14	0.22	21.52*
Identified regulation	11	3182	0.4079	0.39	0.35	0.42	35.41***
Intrinsic motivation	16	4372	0.4222	0.40	0.37	0.43	60.54***
Self-determination	10	8135	0.2739	0.27	0.24	0.29	38.96***
Perceived competence	18	9505	0.2973	0.29	0.27	0.31	30.71*

Note. m = number of observed effect sizes; N = total subjects from observed effect sizes; $\overline{ES}_D$ = mean transformed effect size for meta-analysis group; $\bar{r}$ = mean correlation coefficient; CI = confidence interval; LL = lower limit of the 95% confidence interval; UL = upper limit of the 95% confidence interval, Q_t = statistic to test the homogeneity of each meta-analysis group. Although the relationship between perceived parental autonomy support displayed a significant amount of heterogeneity for both external and introjected regulation, moderator analysis was not conducted for those dependent variables with fewer than six samples contributing to the composite effect. *$p < .05$. **$p < .01$. *** $p < .001$.

Academic Performance

As shown in the first row of the results in Table 4, 14 transformed effect sizes (m = 14) assessed the strength of the relationship between perceived parental autonomy support and academic performance (N = 3905). All 14 effect sizes indicated a positive relationship. The effects ranged from 0.01 to 0.28 (after being Winsorized). The weighted average transformed effect size ($\overline{ES}_D$) was 0.11 which converted to a mean correlation ($\bar{r}$) of 0.11 with a 95% CI from 0.08 to 0.14. Therefore, the hypothesis that the strength of the relationship between

perceived parental autonomy support and academic performance is zero could be rejected. Further, the upper (UL) and lower limits (LL) of the mean correlation coefficient were observed to span the small and medium strength categories of observed effect sizes in behavioural science research[9]. Finally, the test of the distribution of the transformed effect sizes was not rejected at an $\alpha = .05$, supporting the conclusion that the subgroups were homogeneous, $Q(13) = 22.17$, $p > .05$.

As shown in the 12th row of Table 4, all 9 of the transformed effect sizes assessing the strength of the relationship between perceived teacher autonomy support and academic performance ($N = 3040$) indicated a positive relationship. The effects ranged from 0.02 to 0.30. The weighted average transformed effect size was 0.11 which converted to a mean correlation of 0.11 with a 95% CI from 0.07 to 0.15. Therefore, the hypothesis that the strength of the relationship between perceived teacher autonomy support and academic performance is zero was rejected. The upper and lower limits of the correlation coefficient were observed to span the small and medium strength categories of observed effect sizes. The test of the distribution of transformed effect sizes was not rejected, indicating that the effects were therefore homogeneous, $Q(8) = 13.00$, $p > .05$.

The confidence intervals for the mean correlation coefficients for parental autonomy support and perceived teacher autonomy support overlapped (i.e. [.08, .14]; [.07, .15]). Therefore, the strength of the relationship between perceived parental autonomy support and academic performance, and the strength of the relationship between perceived teacher autonomy support and academic performance appears to be statistically equivalent.

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[9] The categories for rating the strength of effect sizes according to Cohen (1988 as cited by Lipsey & Wilson, 2001) are as follows: $|r| \leq 0.10$ = small; $0.10 < |r| < 0.25$ = medium; $|r| \geq 0.40$ = large.

Cognitive Engagement

As shown in the 4th row of Table 4, 6 transformed effect sizes assessed the strength of the relationship between perceived parental autonomy support and cognitive engagement (N = 1998). All 6 effect sizes indicated a positive relationship. The effects ranged from 0.19 to 0.41. The weighted average transformed effect size was 0.30 which converted to a mean correlation of 0.29 with a 95% CI from 0.25 to 0.34. Therefore, the hypothesis that the strength of the relationship between perceived parental autonomy support and cognitive engagement was zero could be rejected. Further, the upper and lower limits of the mean correlation coefficient were observed to span the category of small observed effect sizes. Finally, the test of the distribution of the transformed effect sizes revealed that the effects were homogeneous, $Q(5) = 9.96$, $p > .05$.

All 5 of the transformed effect sizes assessing the strength of the relationship between perceived teacher autonomy support and cognitive engagement indicated a positive relationship (N = 1645). The effects ranged from 0.23 to 0.63. The weighted average transformed effect size was 0.48 which converted to a mean correlation of 0.45 with a 95% CI from 0.39 to 0.51. Therefore, the hypothesis that the strength of the relationship between perceived teacher autonomy support and cognitive engagement was zero could be rejected. The upper and lower limits of the mean correlation coefficient spanned the medium and strong categories of observed effect sizes. The test of the distribution of the transformed effect sizes revealed that the effects were homogeneous, $Q(4) = 9.45$, $p > .05$.

The confidence intervals for the mean correlation coefficients for perceived parental autonomy support and perceived teacher autonomy support did not overlap (i.e., [.25, .34]; [.39, .51]). Therefore, the strength of the relationship between perceived parental autonomy support and cognitive engagement, and the strength of the relationship between perceived

teacher autonomy support and cognitive engagement are not statistically equivalent. There is a stronger relationship between perceived teacher autonomy support and cognitive engagement than between perceived parental autonomy support and cognitive engagement.

External Regulation

Five transformed effect sizes assessed the strength of the relationship between perceived parental autonomy support and external regulation (N = 931). One effect size indicated a positive relationship and 4 indicated a negative relationship. The effects ranged from -0.29 to 0.05. The weighted average transformed effect size was -0.15 which converted to a mean correlation of -0.15 with a 95% CI from -0.21 to -0.08 and the hypothesis that the strength of the relationship between perceived parental autonomy support and external regulation was zero could be rejected. The upper and lower limits of the mean correlation coefficient spanned the category of small and medium observed effect sizes. Finally, the test of the distribution of the transformed effect sizes revealed that the effects were heterogeneous and, as a result, were not likely to be estimating the same underlying population, $Q(4) = 23.40$, $p < .001$.

Of the 12 effect sizes assessing the relationship between perceived teacher autonomy support and external regulation, 9 indicated a negative relationship and 3 indicated a positive relationship. The effects ranged from -0.29 to 0.14. The weighted average transformed effect size was -0.11 which converted to a mean correlation of 0.11 with a 95% CI from -0.15 to -0.07. Therefore, the hypothesis that the strength of the relationship between perceived teacher autonomy support and external regulation was zero could be rejected. The upper and lower limits of the mean correlation coefficient spanned the small and medium categories of observed effect sizes. The test of the distribution of the transformed effect sizes revealed that the effects

were heterogeneous and were therefore not likely to be estimating the same underlying population, $Q(11) = 31.41$, $p < .001$.

The confidence intervals for the mean correlation coefficients derived from perceived parental autonomy support and perceived teacher autonomy support overlapped (i.e., [-.21, -.08]; [-.15, -.07]). Therefore, the strength of the relationship between perceived parental autonomy support and external regulation, and the strength of the relationship between perceived teacher autonomy support and external regulation are statistically equivalent.

Introjected regulation

Six transformed effect sizes assessed the strength of the relationship between perceived parental autonomy support and introjected regulation ($N = 1271$). Two of the effect sizes indicated a negative relationship and 4 indicated a positive relationship. The effects ranged from -0.26 to 0.15 (after being Winsorized). The weighted average transformed effect size was -0.03 which converted to a mean correlation of -0.03 with a 95% CI from -0.09 to 0.03. Given that the confidence interval spanned the value 0, the hypothesis that the strength of the relationship between perceived parental autonomy support and introjected regulation is zero was accepted. Finally, the test of the distribution of the transformed effect sizes revealed that the effects were heterogeneous and as a result were estimating different underlying populations, $Q(5) = 24.87$, $p < .001$.

All 10 of the transformed effect sizes assessing the strength of the relationship between perceived teacher autonomy support and introjected regulation indicated a positive relationship ($N = 2699$). The effects ranged from 0.02 to 0.36. The weighted average transformed effect size was 0.18 which converted to a mean correlation of 0.18 with a 95% CI from 0.14 to 0.22. Therefore, the hypothesis that the strength of the relationship between perceived teacher autonomy support and introjected regulation was zero could be rejected. The upper and lower

limits of the mean correlation coefficient spanned the small and medium categories of observed effect sizes. The test of the distribution of the transformed effect sizes revealed that the effects were heterogeneous, $Q(9) = 21.52$, $p < .05$.

The confidence intervals for the mean correlation coefficients derived from perceived parental autonomy support and perceived teacher autonomy support did not overlap (i.e., [-.09, .03]; [.14, .22]). Therefore, the strength of the relationship between perceived parental autonomy support and introjected regulation, and the strength of the relationship between perceived teacher autonomy support and introjected regulation are not statistically equivalent. There is a stronger relationship between perceived teacher autonomy support and introjected regulation than between perceived parental autonomy support and introjected regulation.

Identified regulation

Six transformed effect sizes assessed the strength of the relationship between perceived parental autonomy support and identified regulation ($N = 1271$). All of the effect sizes indicated a positive relationship. The effects ranged from 0.21 to 0.51. The weighted average transformed effect size was 0.34 which converted to a mean correlation of 0.33 with a 95% CI from 0.28 to 0.38. Therefore the hypothesis that the strength of the relationship between perceived parental autonomy support and identified regulation is zero was rejected. The upper and lower limits of the mean correlation coefficient spanned the medium category of observed effect sizes. Finally, the test of the distribution of the transformed effect sizes revealed that the effects were homogeneous, $Q(5) = 10.08$, $p > .05$.

All 11 of the transformed effect sizes assessing the strength of the relationship between perceived teacher autonomy support and identified regulation indicated a positive relationship ($N = 3182$). The effects ranged from 0.20 to 0.63. The weighted average transformed effect size was 0.41 which converted to a mean correlation of 0.39 with a 95% CI from 0.35 to 0.42.

Therefore, the hypothesis that the strength of the relationship between perceived teacher autonomy support and identified regulation is zero was rejected. The upper and lower limits of the mean correlation coefficient spanned the medium and large categories of observed effect sizes. The test of the distribution of the transformed effect sizes revealed that the effects were estimating different underlying populations and were therefore heterogeneous, $Q(10) = 35.41$, $p < .001$.

The confidence intervals for the mean correlation coefficients derived from perceived parental autonomy support and perceived teacher autonomy support overlapped (i.e. [.28, .38]; [.35, .42]). Therefore, the strength of the relationship between perceived parental autonomy support and identified regulation, and the strength of the relationship between perceived teacher autonomy support and identified regulation are statistically equivalent.

Intrinsic motivation

Ten transformed effect sizes assessed the strength of the relationship between perceived parental autonomy support and intrinsic motivation ($N = 1921$). All of the effect sizes indicated a positive relationship. The effects ranged from 0.11 to 0.39. The weighted average transformed effect size was 0.25 which converted to a mean correlation of 0.25 with a 95% CI from 0.20 to 0.29. Therefore, the hypothesis that the strength of the relationship between perceived parental autonomy support and intrinsic motivation is zero was rejected. The upper and lower limits of the mean correlation coefficient spanned the medium category of observed effect sizes. Finally, the test of the distribution of the transformed effect sizes revealed that the effects were homogeneous, $Q(9) = 11.82$, $p > .05$.

All 16 of the transformed effect sizes assessing the strength of the relationship between perceived teacher autonomy support and intrinsic motivation indicated a positive relationship ($N = 4372$). The effects ranged from 0.22 to 0.69. The weighted average transformed effect size

was 0.42 which converted to a mean correlation of 0.40 with a 95% CI from 0.37 to 0.43. Therefore, the hypothesis that the strength of the relationship between perceived teacher autonomy support and intrinsic motivation is zero was rejected. The upper and lower limits of the mean correlation coefficient spanned the medium and large categories of observed effect sizes. The test of the distribution of the transformed effect sizes revealed that the effects were estimating different underlying populations and were therefore heterogeneous, $Q(15) = 60.54$, $p < .001$.

The confidence intervals for the mean correlation coefficients derived from perceived parental autonomy support and perceived teacher autonomy support did not overlap (i.e. [.20, .29]; [.37, .43]). Therefore, the strength of the relationship between perceived parental autonomy support and intrinsic motivation, and the strength of the relationship between perceived teacher autonomy support and intrinsic motivation are not statistically equivalent. There is a stronger relationship between perceived teacher autonomy support and intrinsic motivation than between perceived parental autonomy support and intrinsic motivation.

Self-determination

Twelve transformed effect sizes assessed the strength of the relationship between perceived parental autonomy support and self-determination ($N = 8087$). All of the effect sizes indicated a positive relationship. The effects ranged from 0.02 to 0.39. The weighted average transformed effect size was 0.19 which converted to a mean correlation of 0.19 with a 95% CI from 0.17 to 0.21. Therefore, the hypothesis that the strength of the relationship between perceived parental autonomy support and self-determination is zero was rejected. The upper and lower limits of the mean correlation coefficient spanned the medium category of observed effect sizes. Finally, the test of the distribution of the transformed effect sizes revealed that the

effects were homogeneous and therefore, were estimating the same underlying population, $Q(11) = 18.80$, $p > .05$.

All 10 of the transformed effect sizes assessing the strength of the relationship between perceived teacher autonomy support and self-determination indicated a positive relationship ($N = 8135$). The effects ranged from 0.12 to 0.51 (after being Winsorized). The weighted average transformed effect size was 0.27 which converted to a mean correlation of 0.27 with a 95% CI from 0.24 to 0.29. Therefore, the hypothesis that the strength of the relationship between perceived teacher autonomy support and self-determination is zero was rejected. The upper and lower limits of the mean correlation coefficient spanned the medium category of observed effect sizes. The test of the distribution of the transformed effect sizes revealed that the effects were estimating different underlying populations and were therefore heterogeneous, $Q(9) = 38.96$, $p < .001$.

The confidence intervals for the mean correlation coefficients derived from perceived parental autonomy support and perceived teacher autonomy support did not overlap (i.e. [.17, .21]; [.24, .29]). Therefore, the strength of the relationship between perceived parental autonomy support and self-determination, and the strength of the relationship between perceived teacher autonomy support and self-determination are not statistically equivalent. There is a stronger relationship between perceived teacher autonomy support and self-determination than between perceived parental autonomy support and self-determination.

Perceived Academic Competence

Eight transformed effect sizes assessed the strength of the relationship between perceived parental autonomy support and perceived competence ($N = 2082$). All of the effect sizes indicated a positive relationship. The effects ranged from 0.06 to 0.26. The weighted average transformed effect size was 0.17 which converted to a mean correlation of 0.17 with a

95% CI from 0.12 to 0.21. Therefore, the hypothesis that the strength of the relationship between perceived parental autonomy support and perceived competence is zero was rejected. The upper and lower limits of the mean correlation coefficient spanned the medium category of observed effect sizes. Finally, the test of the distribution of the transformed effect sizes revealed that the effects were homogeneous and as a result were estimating the same underlying population, $Q(7) = 8.43$, $p > .05$.

All 18 of the transformed effect sizes assessing the strength of the relationship between perceived teacher autonomy support and perceived competence indicated a positive relationship ($N = 9505$). The effects ranged from 0.11 to 0.46 (after being Winsorized). The weighted average transformed effect size was 0.30 which converted to a mean correlation of 0.29 with a 95% CI from 0.27 to 0.31. Therefore, the hypothesis that the strength of the relationship between perceived teacher autonomy support and perceived competence is zero was rejected. The upper and lower limits of the mean correlation coefficient spanned the medium and large categories of observed effect sizes. The test of the distribution of the transformed effect sizes revealed that the effects were estimating different underlying populations and were therefore heterogeneous, $Q(17) = 30.71$, $p < .001$.

The confidence intervals for the mean correlation coefficients derived from perceived parental autonomy support and perceived teacher autonomy support did not overlap (i.e. [.12, .21]; [.27, .31]). Therefore, the strength of the relationship between perceived parental autonomy support and perceived competence, and the strength of the relationship between perceived teacher autonomy support and perceived competence are not statistically equivalent. There is a stronger relationship between perceived teacher autonomy support and perceived competence than between perceived parental autonomy support and perceived competence. The moderator analysis results are described next.

Moderator Analysis

Table 5 presents the results of the moderator analysis for the relationship between perceived teacher autonomy support and external regulation, introjected regulation, identified regulation, intrinsic motivation, self-determination, and perceived competence as a function of the education level of the subject sample used to calculate the observed effect size. Recall that for these six educational outcomes, the Q statistic indicated heterogeneous effect size distributions (See Table 4). Thus moderation analysis was conducted.

Table 5

Results of the Moderation Analysis for the Effect of Perceived Autonomy Support on Select Outcome Variables as a Function of Level of Education

					95% CI for $\bar{r}$			
	k	*n*	$\overline{ES}_{Zr}$	$\bar{r}$	*LL*	*UL*	Q_{wj}	Q_b
External regulation								22.72***
elementary	2	563	-0.0701	-0.07	-0.15	0.01	2.05	
Jr high	2	737	-0.1088	-0.11	-0.25	0.03	5.03*	
Jr-Sr. high	3	1017	-0.0112	-0.01	-0.08	0.05	8.89*	
Sr. high	3	537	-0.2686	-0.26	-0.34	-0.18	0.06	
Post-secondary	2	163	-0.1054	-0.11	-0.26	0.05	0.25	
Introjected regulation								11.48**
elementary	2	563	0.1462	0.15	0.05	0.24	1.93	
Jr high	3	1065	0.2699	0.26	0.20	0.32	4.77	
Jr-Sr. high	2	534	0.0987	0.10	0.01	0.18	0.06	
Sr. high	3	537	0.1475	0.15	0.05	0.24	3.28	

Identified regulation							20.69***
elementary	2	563	0.2796	0.27	0.19	0.35	0.81
Jr high	3	1065	0.4973	0.46	0.40	0.52	6.78*
Jr-Sr. high	3	1017	0.3577	0.34	0.28	0.41	4.31
Sr. high	3	537	0.4986	0.46	0.39	0.53	2.81
Intrinsic motivation							47.12***
elementary	5	1411	0.3116	0.30	0.24	0.36	6.02
Jr high	2	737	0.5262	0.48	0.41	0.55	4.02*
Jr-Sr. high	3	1017	0.3603	0.35	0.28	0.40	3.78
Sr. high	4	731	0.6041	0.54	0.48	0.59	2.36
Post-secondary	2	476	0.5155	0.47	0.31	0.61	3.26
Self-determination							24.39***
elementary	1	806	0.1206	0.12	0.05	0.19	N/A
Jr high	2	1088	0.3615	0.35	0.25	0.43	5.77*
Sr. high	6	6043	0.2884	0.28	0.26	0.31	8.80
Post-secondary	1	198	0.3654	0.35	0.22	0.47	N/A
Perceived competence							6.43
elementary	3	848	0.3369	0.32	0.26	0.38	0.57
Jr high	2	722	0.2766	0.27	0.17	0.37	1.39

Jr-Sr. high	3	1143	0.2459	0.24	0.19	0.30	0.62
Sr. high	6	6059	0.2950	0.29	0.26	0.31	11.28*
Post-secondary	4	733	0.2766	0.27	0.17	0.37	10.43*

Note. k = number of observed effect sizes; n = number of subjects for the observed effect size; $\overline{ES}_z$ = mean transformed effect size; $\bar{r}$ = mean correlation coefficient; CI = confidence interval; LL = lower limit of the 95% confidence interval; UL = upper limit of the 95% confidence interval, Q_{wg} = within groups test for homogeneity, Q_b = between groups test for homogeneity . *$p < .05$. **$p < .01$. *** $p < .001$.

Although the observed effect sizes for the relationship between perceived parental autonomy support and both external and introjected regulation were also identified as heterogeneous (see Table 4), moderator analysis was not conducted for these outcome variables because they contained fewer than 6 effect sizes, which could lead to unreliable interpretations across the multiple levels of education. The moderator results for perceived teacher autonomy support are discussed next.

External Regulation

The relationship between perceived teacher autonomy support and external regulation was found to be significantly different for elementary, juniour high, juniour-senior high, senior high, and post secondary levels of education as indicated by a significant between groups test of homogeneity, $Q_b(4) = 22.72$, $p < .001$. More specifically, the weighted mean transformed effect size for effect sizes derived from elementary students ($k = 2$; $N = 563$) was -0.07, which converted to a mean correlation of -0.07 with a 95% CI of -0.15 to 0.01. Therefore, the hypothesis that a relationship exists between perceived autonomy support and the external regulation of elementary students was not accepted. The observed effect sizes used to calculate the weighted mean effect size were found to be homogeneous, $Q_{wg}(1) = 2.05$.

The weighted mean transformed effect size for junior high students ($k = 2$; $n = 737$) was -0.11, which converted to a mean correlation of -0.11 with a 95% CI of -0.25 to 0.03. Therefore,

the hypothesis that a relationship between perceived autonomy support and the external regulation of junior high students was accepted. The observed effect sizes used to calculate the weighted mean effect size were found to be heterogeneous, $Q_{wj}(1) = 5.03$, $p < .05$, meaning there could be other systematic differences in the observed effect sizes, which were yet to be accounted.

The weighted mean transformed effect size for junior-senior high students ($k = 3$; $n = 1017$) was -0.01, which converted to a mean correlation of -0.01 with a 95% CI of -0.08 to 0.05. Therefore, the hypothesis that a relationship between perceived autonomy support and the external regulation of junior-senior high students was not accepted. The observed effect sizes used to calculate the weighted mean effect size were found to be heterogeneous, $Q_{wj}(2) = 8.89$, $p < .05$, meaning there could be other systematic differences in the observed effect sizes, which have yet to be accounted.

The weighted mean transformed effect size for senior high students ($k = 3$; $n = 537$) was -0.27, which converted to a mean correlation of -0.27 with a 95% CI of -0.34 to -0.18, indicating a medium effect size. Therefore, the hypothesis that a relationship exists between perceived autonomy support and the external regulation of senior high students was not rejected. The observed effect sizes used to calculate the weighted mean effect size were found to be homogeneous, $Q_{wj}(2) = 0.06$.

Finally, the weighted mean transformed effect size for post secondary students ($k = 2$; $n = 163$) was -0.11, which converted to a mean correlation of -0.11 with a 95% CI of -0.26 to 0.05. Therefore, the hypothesis that a relationship between exists perceived autonomy support and the external regulation of post secondary students was not accepted. The observed effect sizes used to calculate the weighted mean effect size were found to be homogeneous, $Q_{wj}(1) = 0.25$.

Comparing the resulting 95% confidence intervals across the levels of education in Table 5 reveals that the relationship between perceived teacher autonomy support and external regulation was statistically different from zero only for senior high school students.

Introjected Regulation

The relationship between perceived teacher autonomy support and introjected regulation was found to be significantly different for elementary, junior high, junior-senior high, and senior high levels of education (no post-secondary students were investigated) as indicated by a significant between groups test of homogeneity, $Q_b(3) = 11.48$, $p < .01$. More specifically, the weighted mean transformed effect size for effect sizes derived from elementary students ($k = 2$; $n = 563$) was 0.15, which converted to a mean correlation of 0.15 with a 95% CI of 0.05 to 0.24, indicating a small to medium effect size. Therefore, the hypothesis that a relationship exists between perceived autonomy support and the introjected regulation of elementary students was not rejected. The observed effect sizes used to calculate the weighted mean effect size were found to be homogeneous, $Q_{wj}(1) = 1.93$.

The weighted mean transformed effect size for junior high students ($k = 3$; $n = 1065$) was 0.27, which converted to a mean correlation of 0.26 with a 95% CI of 0.20 to 0.32, indicating a medium effect size. Therefore, the hypothesis that a relationship exists between perceived autonomy support and the introjected regulation of junior high students was not rejected. The observed effect sizes used to calculate the weighted mean effect size were found to be homogeneous, $Q_{wj}(2) = 4.77$.

The weighted mean transformed effect size for junior-senior high students ($k = 2$; $n = 534$) was 0.10, which converted to a mean correlation of 0.10 with a 95% CI of 0.01 to 0.18, indicating a small to medium effect size. Therefore, the hypothesis that a relationship exists between perceived autonomy support and the introjected regulation of junior-senior high

students was not rejected. The observed effect sizes used to calculate the weighted mean effect size were found to be homogeneous, $Q_{w(j)}(1) = 0.06$.

The weighted mean transformed effect size for senior high students ($k = 3$; $n = 537$) was 0.15, which converted to a mean correlation of 0.15 with a 95% CI of 0.05 to 0.24, indicating a small to medium effect size. Therefore, the hypothesis that a relationship exists between perceived autonomy support and the introjected regulation of senior high students was not rejected. The observed effect sizes used to calculate the weighted mean effect size were found to be homogeneous, $Q_{w(j)}(2) = 3.28$.

Comparing the resulting 95% confidence intervals across the levels of education reveals that for junior high school students there is a stronger relationship between perceived teacher autonomy support and introjected regulation than for junior-senior high school students. All remaining comparisons revealed overlapping confidence intervals and as a result no significant differences.

Identified Regulation

The relationship between perceived teacher autonomy support and identified regulation was found to be significantly different for elementary, junior high, junior-senior high, and senior high levels of education (no post-secondary students were investigated) as indicated by a significant between groups test of homogeneity, $Q_b(3) = 20.69$, $p < .001$. More specifically, the weighted mean transformed effect size for effect sizes derived from elementary students ($k = 2$; $n = 563$) was 0.28, which converted to a mean correlation of 0.27 with a 95% CI of 0.19 to 0.35, indicating a medium effect size. Therefore, the hypothesis that a relationship exists between perceived autonomy support and the identified regulation of elementary students was not rejected. The observed effect sizes used to calculate the weighted mean effect size were found to be homogeneous, $Q_{w(j)}(1) = 0.81$.

The weighted mean transformed effect size for junior high students ($k = 3$; $n = 1065$) was 0.50, which converted to a mean correlation of 0.46 with a 95% CI of 0.40 to 0.52, indicating a large effect size. Therefore, the hypothesis that a relationship exists between perceived autonomy support and the identified regulation of junior high students was not rejected. The observed effect size statistics used to calculate the weighted mean effect size were found to be heterogeneous, $Q_{w/j}(2) = 6.78$; $p < .05$, meaning there could be other systematic differences in the observed effect sizes that have yet to be accounted.

The weighted mean transformed effect size for junior-senior high students ($k = 3$; $n = 1017$) was 0.36, which converted to a mean correlation of 0.34 with a 95% CI of 0.28 to 0.41, indicating a medium to large effect size. Therefore, the hypothesis that a relationship exists between perceived autonomy support and the identified regulation of junior-senior high students was not rejected. The observed effect sizes used to calculate the weighted mean effect size were found to be homogeneous, $Q_{w/j}(2) = 4.31$.

The weighted mean transformed effect size for senior high students ($k = 3$; $n = 537$) was 0.50 which converted to a mean correlation of 0.46 with a 95% CI of 0.39 to 0.53, indicating a medium to large effect size. Therefore, the hypothesis that the relationship between perceived autonomy support and the identified regulation of senior high students was zero is rejected. The observed effect size statistics used to calculate the weighted mean effect size were found to be homogeneous, $Q_{w/j}(2) = 2.81$.

Comparing the resulting 95% confidence intervals across the levels of education reveals that for both junior high and senior high school students (although, not for the combined junior-senior high school students) there is a stronger relationship between perceived teacher autonomy support and identified regulation than for elementary students. All remaining comparisons revealed overlapping confidence intervals and as a result no significant differences.

Intrinsic Motivation

The relationship between perceived teacher autonomy support and intrinsic motivation was found to be significantly different for elementary, junior high, junior-senior high, senior high, and post-secondary levels of education as indicated by a significant between groups test of homogeneity, $Q_b(4) = 47.12$, $p < .001$. More specifically, the weighted mean transformed effect size for effect sizes derived from elementary students ($k = 5$; $n = 1411$) was 0.31, which converted to a mean correlation of 0.30 with a 95% CI of 0.24 to 0.36, indicating a medium effect size. Therefore, the hypothesis that a relationship exists between perceived autonomy support and the intrinsic motivation of elementary students was not rejected. The observed effect sizes used to calculate the weighted mean effect size were found to be homogeneous, $Q_{wj}(4) = 6.02$.

The weighted mean transformed effect size for junior high students ($k = 2$; $n = 737$) was 0.52, which converted to a mean correlation of 0.48 with a 95% CI of 0.41 to 0.55, indicating a large effect size. Therefore, the hypothesis that a relationship exists between perceived autonomy support and the intrinsic motivation of junior high students was not rejected. The observed effect size statistics used to calculate the weighted mean effect size were found to be heterogeneous, $Q_{wj}(1) = 4.02$; $p < .05$, meaning there could be other systematic differences in the observed effect sizes that have yet to be accounted.

The weighted mean transformed effect size for junior-senior high students ($k = 3$; $n = 1017$) was 0.36, which converted to a mean correlation of 0.35 with a 95% CI of 0.28 to 0.40, indicating a medium to large effect size. Therefore, the hypothesis that a relationship exists between perceived autonomy support and the intrinsic motivation of junior-senior high students was not rejected. The observed effect size statistics used to calculate the weighted mean effect size were found to be homogeneous, $Q_{wj}(2) = 3.78$.

The weighted mean transformed effect size for senior high students ($k = 4$; $n = 731$) was 0.60, which converted to a mean correlation of 0.54 with a 95% CI of 0.48 to 0.59, indicating a large effect size. Therefore, the hypothesis that a relationship exists between perceived autonomy support and the intrinsic motivation of senior high students was not rejected. The observed effect sizes used to calculate the weighted mean effect size were found to be homogeneous, $Q_{w/j}(3) = 2.36$.

The weighted mean transformed effect size for post-secondary students ($k = 2$; $n = 476$) was 0.52, which converted to a mean correlation of 0.47 with a 95% CI of 0.31 to 0.61, indicating a medium to large effect size. Therefore, the hypothesis that a relationship exists between perceived autonomy support and the intrinsic motivation of post-secondary students was not rejected. The observed effect size statistics used to calculate the weighted mean effect size were found to be homogeneous, $Q_{w/j}(1) = 3.26$.

Comparing the resulting 95% confidence intervals across the levels of education reveals that for both junior high and senior high school students there is a stronger relationship between perceived teacher autonomy support and Intrinsic motivation than for elementary and junior-senior high school students. All remaining comparisons revealed overlapping confidence intervals and as a result no significant differences.

Self-Determination

The relationship between perceived teacher autonomy support and self-determination was found to be significantly different for elementary, junior high, senior high, and post-secondary levels of education (no junior-senior high school students were investigated) as indicated by a significant between groups test of homogeneity, $Q_b(3) = 24.39$, $p < .001$. More specifically, the weighted mean transformed effect size for effect sizes derived from elementary students ($k = 1$; $n = 806$) was 0.12, which converted to a mean correlation of 0.12 with a 95% CI

of 0.05 to 0.19, indicating a small to medium effect size. Therefore, the hypothesis that a relationship exists between perceived autonomy support and the self-determination of elementary students was not rejected. There was only one observed effect size used to calculate the weighted mean effect size and therefore homogeneity testing did not apply.

The weighted mean transformed effect size for junior high students ($k = 2$; $n = 1088$) was 0.36, which converted to a mean correlation of 0.35 with a 95% CI of 0.25 to 0.43, indicating a medium to large effect size. Therefore, the hypothesis that a relationship exists between perceived autonomy support and the self-determination of junior high students was not rejected. The observed effect sizes used to calculate the weighted mean effect size were found to be heterogeneous, $Q_{WP}(1) = 5.77$; $p < .05$, meaning there could be other systematic differences in the observed effect sizes that have yet to be accounted.

The weighted mean transformed effect size for senior high students ($k = 6$; $n = 6043$) was 0.29, which converted to a mean correlation of 0.28 with a 95% CI of 0.26 to 0.31, indicating a medium effect size. Therefore, the hypothesis that a relationship exists between perceived autonomy support and the self-determination of senior high students was not rejected. The observed effect sizes used to calculate the weighted mean effect size were found to be homogeneous, $Q_{WP}(5) = 8.80$.

The weighted mean transformed effect size for post-secondary students ($k = 1$; $n = 198$) was 0.37, which converted to a mean correlation of 0.35 with a 95% CI of 0.22 to 0.47, indicating a medium to large effect size. Therefore, the hypothesis that a relationship exists between perceived autonomy support and the self-determination of post-secondary students was not rejected. There was only one observed effect size used to calculate the weighted mean effect size and therefore homogeneity testing did not apply.

Comparing the resulting 95% confidence intervals across the levels of education reveals that for junior high, senior high school, and post-secondary students there is a stronger relationship between perceived teacher autonomy support and self-determination than for elementary students. All remaining comparisons revealed overlapping confidence intervals and as a result no significant differences.

Perceived Academic Competence

The relationship between perceived teacher autonomy support and perceived competence was not found to be significantly different across elementary, junior high, junior-senior high, senior high, and post-secondary levels of education as indicated by a significant between groups test of homogeneity, $Q_b(4) = 6.43$. The weighted mean transformed effect size for effect sizes derived from elementary students ($k = 3$; $n = 848$) was 0.34, which converted to a mean correlation of 0.32 with a 95% CI of 0.26 to 0.38, indicating a medium effect size. Therefore, the hypothesis that a relationship exists between perceived autonomy support and the perceived competence of elementary students was not rejected. The observed effect sizes used to calculate the weighted mean effect size were found to be homogeneous, $Q_{w(j)}(2) = 0.57$.

The weighted mean transformed effect size for junior high students ($k = 2$; $n = 722$) was 0.28, which converted to a mean correlation of 0.27 with a 95% CI of 0.17 to 0.37, indicating a medium effect size. Therefore, the hypothesis that a relationship exists between perceived autonomy support and the perceived competence of junior high students was not rejected. The observed effect sizes used to calculate the weighted mean effect size were found to be homogeneous, $Q_{w(j)}(1) = 1.39$.

The weighted mean transformed effect size for junior-senior high students ($k = 3$; $n = 1143$) was 0.25, which converted to a mean correlation of 0.24 with a 95% CI of 0.19 to 0.30, indicating a medium effect size. Therefore, the hypothesis that a relationship exists between

perceived autonomy support and the perceived competence of junior-senior high students was not rejected. The observed effect sizes used to calculate the weighted mean effect size were found to be homogeneous, $Q_{w(j)}(2) = 0.62$.

The weighted mean transformed effect size for senior high students ($k = 6$; $n = 6059$) was 0.30, which converted to a mean correlation of 0.29 with a 95% CI of 0.26 to 0.31, indicating a medium effect size. Therefore, the hypothesis that a relationship exists between perceived autonomy support and the perceived competence of senior high students was not rejected. The observed effect sizes used to calculate the weighted mean effect size were found to be heterogeneous, $Q_{w(j)}(5) = 11.28$; $p < .05$, meaning there could be other systematic differences in the observed effect sizes that have yet to be accounted.

The weighted mean transformed effect size for post-secondary students ($k = 4$; $n = 733$) was 0.28, which converted to a mean correlation of 0.27 with a 95% CI of 0.17 to 0.37, indicating a medium effect size. Therefore, the hypothesis that a relationship exists between perceived autonomy support and the perceived competence of post-secondary students was not rejected. The observed effect sizes used to calculate the weighted mean effect size were found to be heterogeneous, $Q_{w(j)}(3) = 10.43$; $p < .05$, meaning there could be other systematic differences in the observed effect sizes that have yet to be accounted.

Comparing the resulting 95% confidence intervals across the levels of education reveals all of the confidence intervals overlap and therefore education level was not able to account for any statistical differences among mean effect sizes. This result was supported by a non-significant between groups homogeneity statistic, $Q_b(4) = 6.43$.

CHAPTER IV - DISCUSSION

The discussion section is divided into four sections. First, results for the relationship between perceived parental autonomy support and the educational outcomes are discussed. Second, results for the relationship between perceived teacher autonomy support and the educational outcomes are discussed. Within in each of these two sections, two issues are considered: (a) the significance and direction of the resulting average effect sizes are explored, and (b) any variation in effect sizes across the educational level of students is examined. In the third section of the discussion, the results for perceived parental autonomy support and perceived teacher autonomy support are compared. Finally, in the fourth section, implications for future research and practical application are offered.

The Relationship between Perceived Parental Autonomy Support on Educational Outcomes

The Significance and Direction of the Relationships

The results of the meta-analysis suggest that perceived parental autonomy support is significantly and positively related to academic performance, cognitive engagement, identified regulation, intrinsic motivation, self-determination, and perceived competence. The results also reveal that perceived parental autonomy support is significantly and negatively related to external regulation, but not significantly related to introjected regulation. These results match the predictions outlined at the beginning of the thesis with the exception of the relationship between perceived autonomy support and introjected regulation. That is, according to self-determination theorists, autonomy support should be negatively correlated with introjected regulation because introjected regulation refers to behaving simply because rules are in place instead of for reasons that are personally valued. However, the result from the meta-analysis suggests that students' perceptions of parental autonomy support are not related to their introjected regulation.

One possible explanation for the apparent mismatch between theory and empirical observation might have to do with how introjected regulation is being operationalized in the studies summarized in the meta-analysis[10]. After taking a closer look at the introjected subscale of the SRQ, it became apparent that some of the items might be addressing issues outside the definition of introjected regulation. For example, one item asks students to rate, using a 4-point Likert scale, whether the reason that they try to do well in school is because they "will feel really proud of [themselves] if [they] do well." This item appears to be focusing more on the feelings elicited by engaging in a given behaviour rather than the reasons for behaving according to introjected regulation. For example, when students follow rules because they are in place rather than because they value the importance of the rules (Deci & Ryan, 2000). A second item from the SRQ asks students to rate whether the reason they try to do well in school is because their "teachers will think [they are] a good student." This item appears to be more evaluative than the definition of introjected regulation would suggest. That is, the definition of introjected regulation does not differentiate between behaving *because* of fear of evaluation or *despite* the fear evaluation. Had a more explicit measure of introjected regulation been developed, one containing items designed to differentiate between acting for a valued reason versus acting simply because rules are in place, the relationship between perceived parental autonomy support and introjected regulation may have been found to match the definition presented in self-determination theory. The strengths of the relationships across the educational level of students are described next.

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[10] It could also be that the perceived autonomy support measure is causing the problem but based on the meta-analysis results, it is less likely because the perceived autonomy measure relates as would be expected to the other variables assessed in the synthesis.

Differences Across Education Level

With the exception of external regulation and introjected regulation, it appears that the strength of the relationship between perceived parental autonomy support and the educational outcomes analyzed in the meta-analysis did not differ across educational level. The result was evidenced by the non-significant *Q* statistics for each outcome variable. One explanation for the apparent homogeneity across educational level might have to do with the enduring nature of the parent-child relationship. That is, it could be that the parents represent a relatively stable influence in a child's life so that the values that they impart to their children and ultimately the manner in which they support their child's autonomy remains largely unchanged across the duration of a students' academic career. As a result, the nature and strength of the relationship between perceived autonomy support and the educational outcomes would be similar regardless of their level of education (i.e. the grade level of the student).

For the relationship between perceived parental autonomy support and both external regulation and introjected regulation, the results suggest there is some systematic difference in the effect sizes used to calculate the mean effect size (see Table 4; also pg. 59). However the present analysis was unable to verify that this systematic difference was the result of the education level of the subjects used to generate each effect size. There too few effect sizes used to generate the average effect size and moderation analysis could not be done. As a result, the reason for the difference in effect sizes for these two variables remains unclear. The relationships between perceived teacher autonomy support and the dependent variables are considered next.

The Relationship between Perceived Teacher Autonomy Support and Educational Outcomes

The Significance and Direction of the Relationships

The results of the meta-analysis suggest that perceived teacher autonomy support is significantly and positively related to academic performance, introjected regulation, self-determination, perceived competence, cognitive engagement, identified regulation, and intrinsic motivation. Results also reveal that perceived teacher autonomy support is significantly and negatively related to external regulation. The nature of these relationships match the hypotheses put forth by self-determination theory with one exception; the relationship between autonomy support and introjected regulation appears to be in the opposite direction of what is expected. That is, the more supportive students perceive their teacher to be, the more these students are to engage in introjected regulation.

As was the case with perceived parental autonomy support, self-determination theory predicts that perceived teacher autonomy support should be negatively correlated with introjected regulation. The result from the meta-analysis fails to support this prediction and suggests that the more autonomy supportive a teacher is perceived to be, the more likely students are to regulate their behaviour based on a passive following of rules rather than on satisfying their inner values and beliefs. Once again, there appears to be a problem with how introjected regulation is being operationalized. Because the same measure was used to operationalize introjected regulation in studies of teacher autonomy support as was used in the parental autonomy support analysis, the same problems seem to exist. That is, the items in the introjected regulation scale of the SRQ appear to be measuring factors outside of the definition of introjected regulation put forth by Deci and Ryan (2000). A more explicit measure of introjected regulation containing items designed to differentiate between acting for a valued reason versus acting simply because rules are in place could have lead to more consistent results

for the relationship between perceived teacher autonomy support and introjected regulation. Differences across the education level of students are discussed next.

Differences Across Education Level

Homogeneity tests revealed that the observed effect sizes for the relationships between perceived teacher autonomy support and academic performance and cognitive engagement did not differ across education level as indicated by non-significant Q statistics (Q = 13.00, Q = 9.45, respectively). Conversely, the observed effect sizes for the relationships between perceived teacher autonomy support and external regulation, introjected regulation, identified regulation, intrinsic motivation, self-determination, and perceived competence were found to be heterogeneous (Q = 31.41, p<.001; Q = 21.52, p<.05, Q = 35.41, p<.001; Q = 60.54, p<.001; Q = 38.96, p<.001; Q = 30.71, p<.05). These observed effect sizes were also found to vary significantly depending on the educational level of students. Specifically, for the relationship between perceived autonomy support and external regulation, moderation analyses revealed that only senior high school students produced a significant positive mean correlation coefficient ($\bar{r}$ = 0.26), mean effect sizes for the remaining levels of education were non-significant. For the relationship between perceived teacher autonomy support and introjected regulation, moderation analysis revealed that junior high school students produced a stronger mean correlation coefficient ($\bar{r}$ = 0.26) than students from junior senior high school ($\bar{r}$ = 0.10). For relationship between perceived teacher autonomy support and identified regulation, students from junior high and senior high produced a stronger mean correlation ($\bar{r}$ = 0.46 and $\bar{r}$ = 0.46, respectively) than students from elementary school ($\bar{r}$ = 0.27). Similar findings were revealed for intrinsic motivation. Students from junior and senior high showed stronger relationships between perceived teacher autonomy support and intrinsic motivation ($\bar{r}$ = 0.48 and $\bar{r}$ = 0.54, respectively) than students in elementary ($\bar{r}$ = 0.30). In terms of self-

determination, elementary students had a weaker relationship with ($\bar{r}$ = 0.12) perceived teacher autonomy support than junior high, senior high, and post-secondary education students ($\bar{r}$ = 0.35, $\bar{r}$ = 0.28 and $\bar{r}$ = 0.35, respectively). Finally, for perceived competence, the heterogeneity in the observed effect sizes could not be explained by differences in levels of education.

When considering the results of the moderation analysis together, differences in the observed effect sizes for the motivation variables were consistently attributed to students from higher levels of education, who showed a stronger relationship with perceived teacher autonomy support than students from lower levels of education. This observation suggests that, in general, the higher the level of education of the student, the stronger the relationship between perceived teacher autonomy support and motivation outcomes. A possible explanation for these results might be that students from lower levels of education are already functioning at high levels of autonomy and are might therefore be less affected by perceptions of autonomy support provided by teachers. Further, it could be that students' sensitivity to autonomy support increases as they progress through the education system because they experience an increased lack of control over their learning in higher grades.

An alternative explanation for why students in higher grades appear to produce stronger correlations between perceived teacher autonomy support and motivational outcomes might be that older students' identity formation aligns more closely with how autonomy support is operationalized in the observed studies. That is, according to Erickson's (1959) theory of psychosocial development, children move through stages of identity formation as they grow and develop. In the elementary years (age 7-10) of school, healthy student identities are characterized by a need to demonstrate industry by being responsible and doing right. As a result, autonomy support behaviour that focuses on providing students with the opportunities

to demonstrate competence might be more relevant when investigating the relationship between perceived autonomy support and motivation outcomes. As children move through to junior and senior high (age 10-18), healthy identity formation is characterized by a sense of independence and a need to appear positively in the eyes of others. Consequently, autonomy support behaviour that focuses on helping students experience more control over how they are perceived by others may become more relevant when investigating the relationship between perceived autonomy support and motivation outcomes. In order to investigate theses claims, the items of the LCQ were reviewed to see which types of behaviours they asked students to assess. After inspecting the items of the LCQ, it appears that almost all of the items asked students to rate the degree to which they agree that their teacher uses behaviours that focused on providing students with opportunity for choice or acknowledging their points of view; for example, "I feel that my instructor provides me with choices and options" and "I am able to be open with my instructor during class." Only one item indirectly asked students to rate the degree to which their teacher provided opportunities to demonstrate their competence: "My instructor conveyed confidence in my ability to do well in the course." Based on the items contained in the LCQ and Erickson's stages of psychosocial development, the results of the meta-analysis appear to be understandable. That is, students in earlier levels of education did not find the behaviours in the LCQ to represent autonomy support. It should be noted, however, that although the explanations offered for the observed meta-analysis results might appear reasonable, further research is needed to support these claims. In the next section, the differences were found between the effects of perceived parental and perceived teacher autonomy support are discussed.

Comparing Perceived Parental and Perceived Teacher Autonomy Support

The results of the meta-analysis revealed differences between the strength of some of the relationships investigated. For example, perceived teacher autonomy support was shown to be more strongly related to cognitive engagement, intrinsic motivation, self-determination, and perceived competence than perceived parental autonomy support. The results seem to suggest that perceived teacher autonomy support is, in general, more strongly related to educational outcomes. One possible explanation for this apparent trend is that context plays an important role in determining the strength of the observed relationships. That is, for each of the relationships analyzed in the review, the measures of the dependent variables were necessarily set within an educational context. For example, the perceived competence measures asked students to rate their perceived competence in their academic abilities. Likewise, all of the remaining dependent measures were education based. Further, the perceived teacher autonomy support measure was also highly situated within an education context. Alternatively, the perceived parental autonomy support measures were typically more global in their assessment of autonomy support behaviours. For example, some of the parental autonomy support items asked students to rate the degree to which their parents listened to their opinion. These items make no specific reference to whether the opinion had to do with school related behaviour or some other type of behaviour. Considering these observations, it is not surprising that perceived teacher autonomy support was consistently more highly related to the educational variables assessed in the meta-analysis. This conclusion, as well as each of the claims that have been made through out the preceding discussion, has implications for future research and practical application; these implications are discussed next.

Implications for Future Research and Practical Application

For each of the findings produced and discussed in the meta-analysis there are theoretical and practical implications. First, the nature of the relationship between perceived autonomy support and introjected regulation did not match the predictions expected based on self-determination theory. According to self-determination theory, perceived autonomy support, whether it be from parents or teachers, should negatively relate to non-self-determined forms of regulation. Instead, the meta-analysis revealed a non-significant relationship between perceived parental autonomy support and introjected regulation and a significant positive relationship between teacher autonomy support and introjected regulation. After inspecting the measurement instrument used to operationalize introjected regulation, it was suggested that the cause of the inconsistent results might be due to items from the introjected subscale of the SRQ. The items may be measuring something other than introjected regulation as defined by self-determination theory. The primary implication of this result is that the introjected subscale of the SRQ needs to be subjected to some form of validity analysis. If the validity analysis reveals that items are in fact not valid indicators of introjected regulation, new items that align with the accepted definition of introjected regulation should be developed. If the items are found to be valid, how autonomy support is being defined and used in the classroom must be reconsidered. That is, based on the meta-analysis results, something about how autonomy support is provided by teachers is relating positively to introjected regulation. To maximize the benefits of autonomy support as described by self-determination theory, the behaviours that are responsible for the positive relationship to introjected regulation should be identified so that they can be removed or at least reduced at the classroom level.

The next finding uncovered by the results was that, in general, the strength of the relationships between perceived autonomy support and each of the motivation variables

considered in the review (external regulation, introjected regulation, identified regulation, intrinsic motivation, and self-determination) were stronger for students in higher levels of education than for students in lower levels. The explanation offered for this result was that students at a younger age may perceive autonomy support differently than students at higher levels of education. The primary implication of this finding is that educators may need to reconsider how autonomy support is being provided in the lower grade levels. What appears to be autonomy supportive for an elementary student might not be autonomy supportive for a senior high school student. In order to get a truer sense of how autonomy support relates to education outcomes for students in elementary school, autonomy support may need to be operationalized differentially to account for developmental shifts in students affinity to certain behaviours. For example, through the elementary grades, it could be that autonomy support is more synonymous with providing opportunities to display competence rather than providing opportunities for choice. Further, in the higher grade levels, it could be that autonomy support is more synonymous with acknowledging student opinions than it is about providing opportunities to display competence. In any case, the results suggest that perceived autonomy support is less associated with motivation at the lower grades than at the higher ones. According to self-determination theory, there is no reason for the weaker relationship to be observed for students in elementary grades; further research is required to try to explain why this is in fact the case.

Finally, the meta-analysis results suggest that perceived teacher autonomy support is more strongly associated with all of the variables considered in the review (with the exception of academic performance) than perceived parental autonomy support. It was suggested that the relationships were shown to be stronger for teachers because both the perceived autonomy support measure and the dependent measures were set explicitly within an education context.

In contrast, the perceived parental autonomy support measure was developed at a more global level. One implication of this finding is that in order for parents to have more influence over student motivation, perceived competence and cognitive engagement, their autonomy support should be more education based. On a broader scale, the result implies that the more closely that autonomy support behaviour aligns with the type of behaviour for which motivation and performance is being measured, the stronger the resulting relationship. For example, it could be that general autonomy support behaviours are less effective than domain specific autonomy support behaviours. If this is the case, the way autonomy support is delivered across academic domains might need to be reconsidered. Further research is required to determine if autonomy support is perceived differently across subject areas.

Conclusion

Does autonomy support from teachers and parents significantly relate to the educational variables considered in this review? The results from the meta-analysis supports the prediction that both perceived parental autonomy support and perceived teacher autonomy support are associated positively with academic performance, cognitive engagement, identified regulation, intrinsic motivation, self-determination, and perceived competence and negatively associated with external regulation. Alternatively, the results did not support the prediction that autonomy support relates negatively to introjected regulation. Instead it was found that perceived parental autonomy support did not significantly relate to introjected regulation and perceived teacher autonomy support was positively related to introjected regulation. When comparing the weighted mean correlations of the studies that measured perceived parental autonomy support to the weighted mean correlations of the studies that measured perceived teacher autonomy support, differences in the strengths of these relationships were revealed. Specifically, the meta-analysis showed that perceived teacher autonomy support was more

strongly related to cognitive engagement, intrinsic motivation, self-determination, and perceived competence, than perceived parental autonomy support.

Do the observed correlations of the relationship between perceived teacher autonomy support and the educational outcomes vary as a function of the educational level of the sample? The result of a moderation analysis of studies that measured perceived teacher autonomy support showed that, in general, the higher the level of education, the stronger the magnitude of the relationship between perceived teacher autonomy support and external regulation (i.e. in this case this was a negative association), introjected regulation, identified regulation, intrinsic motivation, and self-determination (i.e., a positive association).

When the results of the meta-analysis are considered together, there is evidence to suggest that autonomy support plays a significant role in educational motivation, cognitive engagement, perceived competence and performance. These findings suggest that students might benefit from teachers incorporating autonomy supportive teaching strategies into their classrooms. The following strategies, as identified from the literature review, might be useful in creating autonomy supportive classrooms. First, teachers may want to employ a communicating style that more strongly involves students in guiding the direction of the learning process. That is, by explaining in more detail why certain tasks are important while at the same time offering students opportunities to contribute to the discussion of how learning should progress, students might gain a stronger sense of autonomy and a higher level of motivation. Second, teachers might consider building more opportunities for meaningful choice into their instruction while at the same time creating more relevant learning tasks. For example, teachers could incorporate authentic assessment tasks into their lesson planning. In an authentic assessment task students are first introduced to a problem that is set within a real world context in which the students are asked to take on a very practical role. Students are provided with general guidelines about what

is required to complete the task, but for the most part, are expected to make important decisions about the best way to achieve the goals of the task on their own. These tasks not only appeal to student interests because they are set in real world contexts, but also create the opportunity for students to take control over how they will demonstrate their learning. The use of authentic assessment tasks might lead to increased perceptions of autonomy support and, as a result, higher motivation and performance. It should be noted, however, that these recommendations for developing autonomy supportive classrooms require empirical investigation before the effects on motivation and performance can be verified. Further research investigating the effect of specific autonomy support techniques is required to more clearly understand what teachers can do to create more autonomy supportive classrooms. For a more complete discussion of what teachers say and do to support autonomy in the classroom, readers are referred to Reeve and Jang (2006) and Stefanou, Perencevich, DiCintio, and Turner (2004).

The results of the moderation analysis also add to the discussion of how autonomy support relates to educational outcomes by identifying significant differences in the strengths of certain relationships based on the level of education for whom it is being provided. It appears that what is autonomy supportive for elementary students might not be the same as what is autonomy supportive for students in Jr high, high school, or post-secondary education. Recognizing that the strength of the relationship between perceived autonomy support can vary based on student level of education is a step towards better understanding how to maximize the potential benefits of autonomy support in education. Further research is required to better understand what it means to support autonomy at the early stages of education compared to what it means to support autonomy at the later stages of education.

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